

TPC OPERATIONS MANUAL

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3/14/00

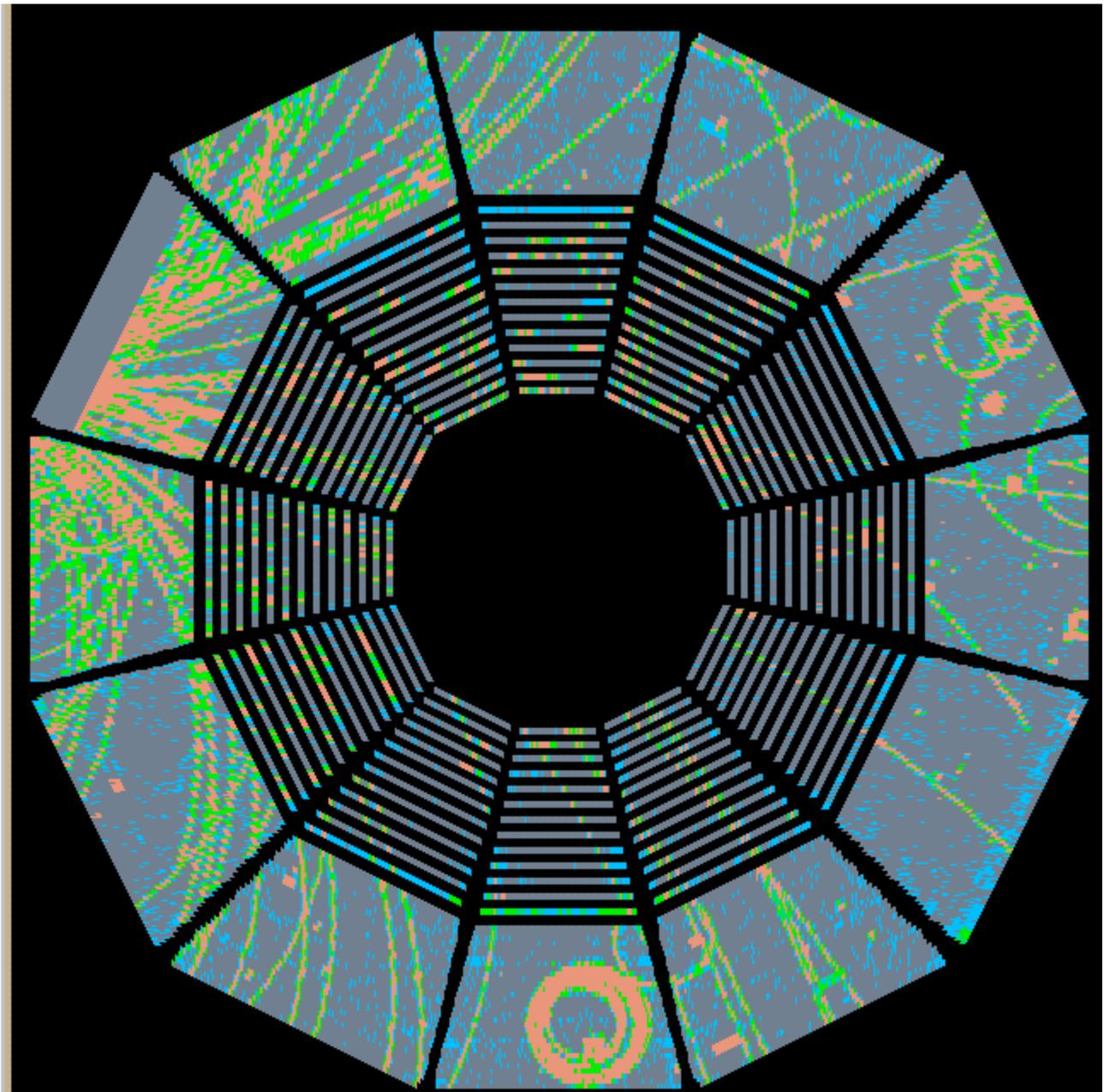


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I. GETTING STARTED

1. Logon to CHAPLIN.STAR.BNL.GOV in the STAR control room. This is the main TPC controls computer.

Username:

Password:

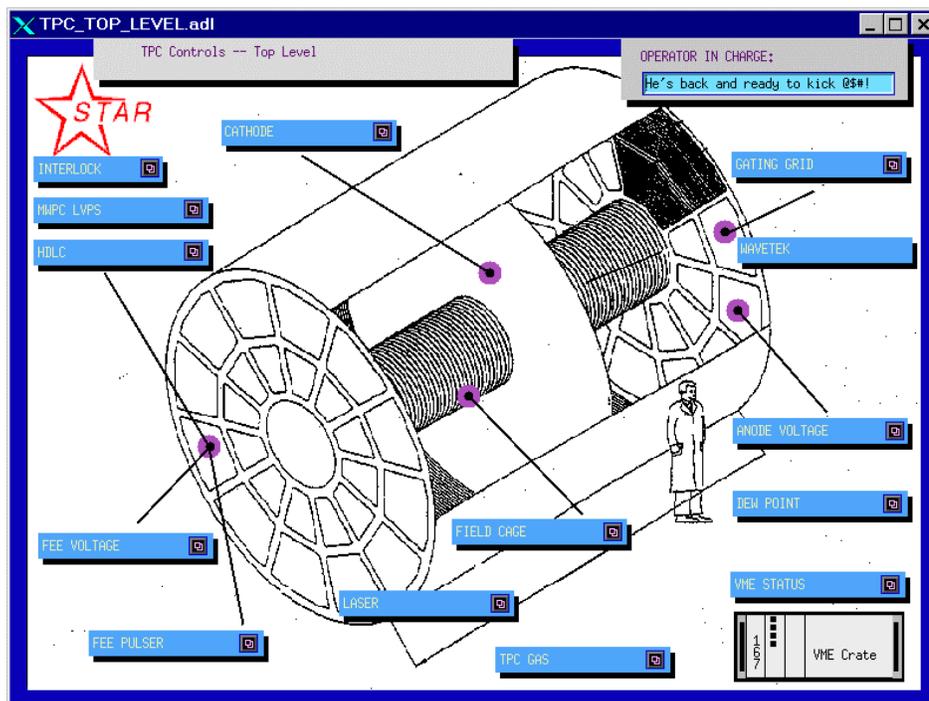
2. CHAPLIN has been setup with a virtual desktop system so that each TPC subsystem can be controlled from its own desktop. This helps reduce “window clutter.” The nine desktops are assigned as follows:

1. Anode HV
2. Cathode/Field Cage
3. Gating Grid
4. FEE
5. Laser Control
6. Gas System Readout
7. Interlock Readout
8. VME Crate Control
9. Pad Monitor/General Use

The virtual desktop icon is usually located in the upper right hand corner of the screen and looks like this:



Select desktop #1 (left click). Then double-click on the Exceed shortcut “sysuser_slow_controls_Chaplin.xls” located on the desktop. This will start a session on the slow controls computer called “SC_Parent_sysuser” which will act as a console window. DO NOT kill this window or all TPC control windows will die with it. In addition, a GUI called TPC_TOP_LEVEL.adl will start. This is the window used to start the various EPICS control programs for the TPC. It looks like this:



Note: As an extra level of security, the anode and cathode controls can only be operated by logging on to slow controls as sysuser. To run other systems one can just logon to slow controls as “startpc” with the same password as for CHAPLIN. There is an EXCEED shortcut located in the “exceed shortcuts” folder called “Chaplin_Slow_Controls.xls” which will do this.

3. On the virtual desktop icon, select desktop 1 and then click here



This will show the open processes for desktop #1. Right click once on “TPC_TOP_LEVEL.adl”, drag down to “Link to Desktop” and then drag down to “All”. Right click again. This will put the top level GUI on all desktops. Do the same for the process “SC_Parent_sysuser. Then left click “close”.

4. Before attempting to turn on any voltage, it must first be determined that the gas system is in a safe mode. In the gas mixing room there are a few gauges that need to be checked;

- In Rack 3, M1 (Oxygen) must be below 80 ppm and M3a (Return Methane) must be between 9.5% and 10.5%
- In Rack 1, M4 (supply Methane content) must be between 9.5% and 10.5% and PI8 (TPC pressure) should be between 1700 and 2200 μ bar.
- In Rack 4, M8 (Gap methane) should be below 15%, M6 (gap oxygen) must be below 40 ppm and FI51 (Nitrogen flow to gap) must be between 5 and 15 lpm.
- Also in Rack 4 check the Allen Bradley interlock system light panel. For normal operations all lights should be green – this indicates that all interlocks are satisfied. For safety reasons, the interlock for the cathode HV may be forced off (flashing red). If the cathode will be turned on, push the green button above the flashing red button (marked Cathode HV enabled). The button should stay green.
- Make sure that the gas system alarms are enabled. For software alarms, check that the gas system control program on the PC in Rack 1 says “alarms enabled.” For hardware alarms, the key for the hardware alarm box in Rack 2 should point to “enabled”.

NOTE1: For any indications that the interlocks are not satisfied, or that the gas system is out of range, contact a TPC expert. Both the gas system and the Allen Bradley interlock system are automatic safety systems that protect the TPC – NO attempt should be made to bypass or defeat these systems.

NOTE2: During normal operations, the interlock status can be checked using slow controls. Click on desktop #7 and select “Interlock”. This will bring up a GUI representation of the TPC interlocks. For interlock problems, consult the TPC Interlocks Manual.

II. VME CRATES

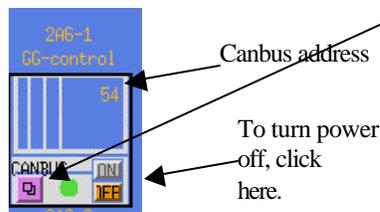
All TPC voltages are controlled with VME CPU's which are located in VME crates on the south platform. These crates can be remotely controlled using slow controls. For the TPC, one VME crate is in rack 2B5 (for the FEE power supplies), with the rest being distributed throughout rack row 2A.

1. On Chaplin, select Desktop #8 (VME Status). On the top level medm GUI click on "VME Status". In the control window confirm that all VME crates in Rack Row 2A and 2B are on (green light).



If the word "interlocked" appears where the green light should be then the safety interlock for that crate has not been satisfied. (The crates where the interlock keeps the power from coming on are 2A6-2, GG-driver and 2A5, GP-pulser). Consult the TPC Interlocks manual for interlock problems.

2. For crates that are not on, click the "on" button. The green light should come on. You can also check the status for each crate (DC voltages, fan speed, temperature etc) by clicking on the Canbus button and dragging down to "VME-xx" where xx is the Canbus address for the crate.



3. Troubleshooting: From time to time the controls systems can get in an unknown state and it may be necessary to cycle the power for the VME crate. **BE VERY CAREFUL BEFORE YOU DO THIS!** Cycling the power will reboot any VME processors in that crate (there can be multiple processors in a crate), and this will affect the voltages on the TPC. At the very least, the voltages for the affected system should be run to zero before cycling power. When in doubt, consult a TPC or slow controls expert.

See the section on VME processors for a simpler way to reboot an individual CPU.

III. VME PROCESSORS

Typically, there is one VME processor for each TPC control task. These processors run VxWorks and boot from the main slow controls computer (sc.star.bnl.gov). There are two connections for each CPU, one via ethernet and one through a terminal server. Remote login over ethernet is reserved for slow controls experts (for security reasons). It may be necessary from time to time to reboot these CPU's. This can be done by logging in to the CPU through the terminal server.

To login through the terminal server:

1. On the Chaplin desktop, doubleclick on the scsession.xs shortcut. This will start a session on sc.star.bnl.gov
2. At the prompt, type "telnet scserv xxxx", where xxxx is the terminal server port for the CPU. At present, the ports are assigned as follows:

Cathode HV	9005
Field Cage readout	9001
Ground Plane Pulser	9011
Gated Grid	9002
Outer Anode HV	9013
Inner anode HV	9006
Interlock, gas system	9012
FEE Power Supplies	9004

3. After you are attached to the processor, hit CR.
4. To reboot the processor, type reboot.
5. After the reboot, it is generally a good idea to logout and release the port. To do this type "Ctrl]" simultaneously, then type "quit". This returns you to sc. Type exit to close the session.

Troubleshooting:

1. When trying to connect to a CPU through the terminal server, the login is refused. It probably means some one else is already attached to that port. Contact a slow controls expert.

IV. FEE and MWC VOLTAGES

The low voltage power supplies for the TPC FEE's and MWC front end cards can be powered on/off remotely using separate slow controls GUI's.

FEE's

The FEE power supplies are located in racks 2B1-2B4 and 2B6-2B9 on the south platform. Rack 2B5 has the VME crate and CPU. To turn on:

1. Select Desktop # 4 (FEE)
2. On the top level GUI, click on the FEE Voltage icon.
3. For each supersector, power supplies N1 and N2 are for the inner sector readout boards. (RDO's) and N3-N6 are for the outer sectors. The power supplies can be turned on individually or by rack (three supersectors) or by east or west end, or for the whole TPC. (The power supplies come on in sequence to avoid power surges.) Click "on" for your selection.
4. To turn the FEE's off, click the appropriate "off" button. In normal operation, the FEE's should be left off unless the TPC is taking data (especially if the experiment is not manned after hours). In addition:

THE FEE AND MWC POWER SUPPLIES MUST BE TURNED OFF WHEN THE MAGNET IS RAMPING UP OR DOWN!

MWC's

The MWC cards are used in the trigger and are powered separately. The power supplies are located in Rack 1B3 on the south platform.

EVEN IF THE MWC ARE NOT BEING USED FOR THE TRIGGER THEY STILL SHOULD BE POWERED ON DURING DATA TAKING, since they terminate the TPC anode wires.

1. Select Desktop #4 (FEE)
2. On the top level GUI, click on the "MWPC LVPS" icon.
3. Click on the global on button.
4. The same caveats apply as for the FEE's. Turn the MWC off when not taking data and during magnet ramps.

INTERLOCKS

1. Air blower: At the bottom of each rack there is an air blower which supplies cooling air for each power supply in that rack. Inside each blower, there is an air flow switch so that if the blower stops, all the power supplies in that rack are turned off. If one rack of power supplies won't come on, that is probably the reason. It would require an access to fix this.
2. TPC water skid: The cooling water for all TPC electronics is supplied by the TPC water skid located in the second floor utility room at STAR (east end of assembly building.) The skid is designed to supply water at a temperature of 75 ° F. The skid exchanges its heat with the STAR Modified Chilled Water (MCW) which is the same water that cools the platform and DAQ racks. Typically, the MCW temperature needs to be 60 – 62 °F for the TPC skid to maintain its setpoint when the FEEs are powered.

The FEE and MCW power supplies are interlocked so that if the flow stops the power supplies turn off. This is done automatically through the TPC interlock system. There are five flowmeters for the TPC. The flow rates are displayed on a panel in Rack 2A9 and also on the Interlocks GUI (Desktop 7).(For more information on the interlock system, see the TPC Interlocks Manual.

Problems with the TPC water skid, MCW etc need to be addressed by a STAR shift leader who will contact the appropriate experts (pump room, STAR ops, TPC etc)

TEMPERATURE MONITOR

Thermocouples (120 total) have been placed on the TPC FEE/RDO cooling manifolds to monitor the temperature. The readings from these thermocouples are recorded by a PC which is located in Rack 2A4 on the platform. To see the current readings and view past history, use Netscape or Explorer to go to <http://tpctemp.star.bnl.gov/> The readings are updated every few seconds, and at the bottom of the page it is possible to pull up a graph of any individual thermocouple (or the average) for the past hours or days.

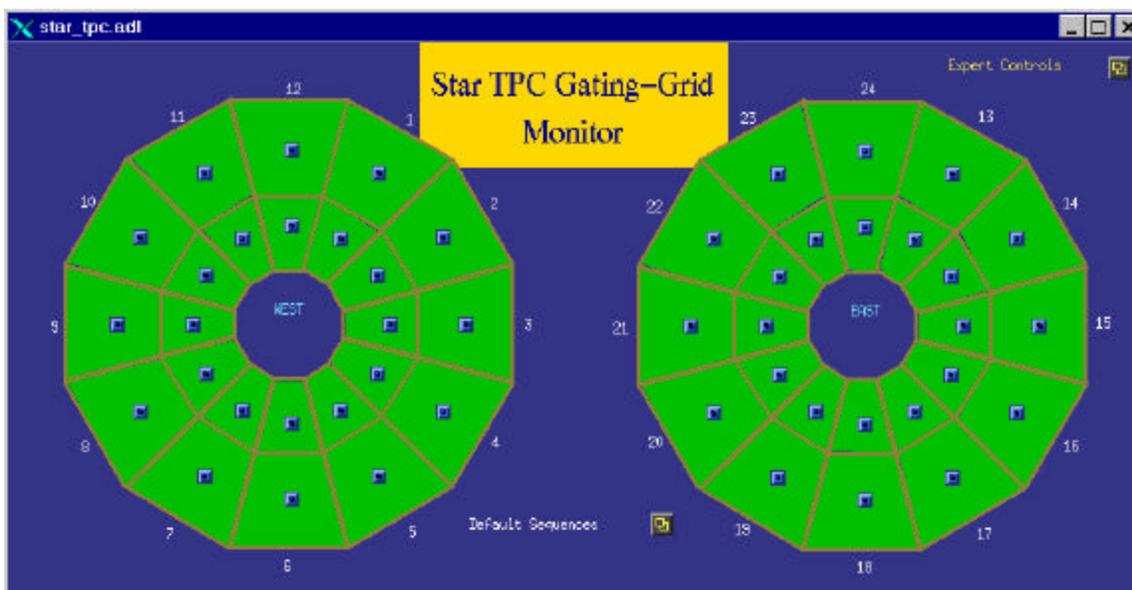
NOTE: IT IS VERY IMPORTANT TO KEEP THE TPC TEMPERATURE BELOW 80 ° F. TEMPERATURES ABOVE 80 CAN RESULT IN STRUCTURAL DAMAGE TO THE TPC. IF IN DOUBT, POWER OFF THE FEE'S AND CALL AN EXPERT.

V. GATED GRID

The gated grid is a plane of wires above the anodes that, when energized (closed), prevents ionization in the TPC from reaching the anodes. After a valid trigger, the gated grid is opened for a fixed time (currently $\sim 60 \mu\text{sec}$). The gated grid system is located in two crates in Rack Row 2A6, the top crate containing the VME CPU and control modules and the next crate containing the HV drivers. The signal to open the gated grid comes from the TPC TCD located in Rack 1A2 (output J2). It is also possible to open the gated grid continuously (for laser runs etc).

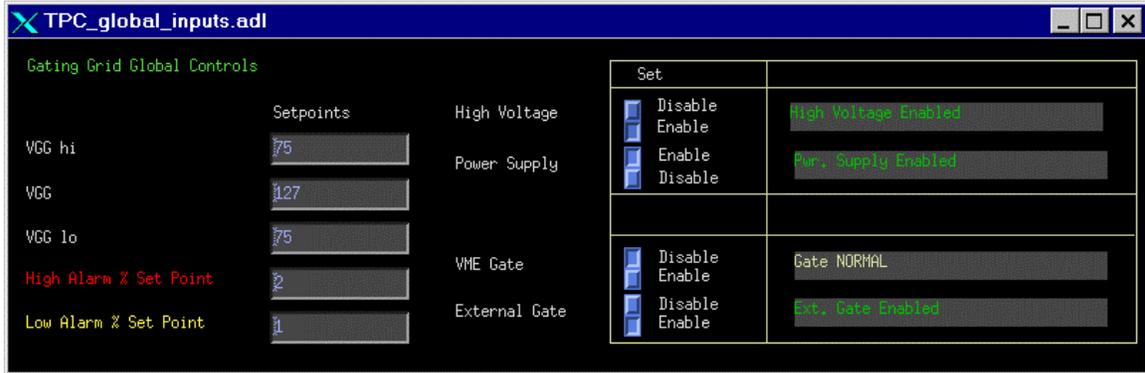
TO TURN ON THE GATED GRID:

1. Select Desktop # 9 and click on “VME Status” on the top level GUI.
2. Check that crates 2A6-1 (GG Control) and 2A6-2 (GG-driver) are on. If not, turn them on (2A6-1 first). There is a safety interlock for crate 2A6-2 that can prevent it from turning on – if this is the case refer to the TPC Interlock Manual or call an expert.
3. Select Desktop #3 (Gating Grid) and click on “Gating Grid” on the top level GUI. This will bring up the Gating Grid Monitor and control screen. All sectors should be red.
4. Click on the button labeled “Default Sequences”. This will bring up the auto sequence window.
5. Click on the button labeled “Grid On”. The status should change from “Idle” to “Downloading Setpoints”. Wait ~ 5 minutes for the voltages to be turned on in sequence. If, after clicking “Grid On” the status remains “idle” it may be necessary to reboot the VME processor. See that section of this manual.
6. After the voltages are set, close the sequence window. In the monitor window, all sectors should now be green:



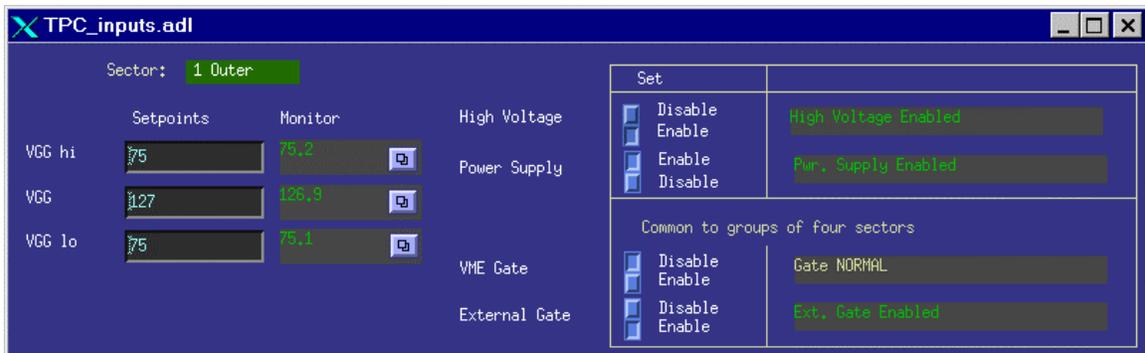
7. To check on the voltage setpoints, click on the “expert controls” button. This will open the control window. Click on the “Global Controls” button.

8. For normal running, the settings should be:



VGG, VGG hi and VGG lo have been calculated to properly terminate the field cage drift field and should only be changed by an expert. The low and high alarm set points determine when the color field on the monitor screen changes for each sector. Thus, a voltage that deviates 1% from the setpoint will show up as yellow, 2% will be red.

To see the actual voltage on an individual sector, click on the button for that sector on the monitor GUI. For each sector, the window looks like:



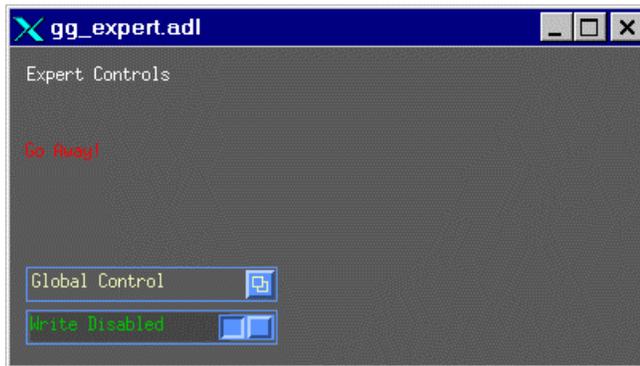
To see a strip chart of a monitored voltage, click on the button to the right of that voltage.

NOTE: For normal operations, all sectors should be green or yellow. Sectors displaying red should be investigated, and the run stopped. Incorrect voltage on the gated grid causes distortions in the TPC drift field. Contact a TPC expert.

TO RUN WITH THE GATED GRID OPEN:

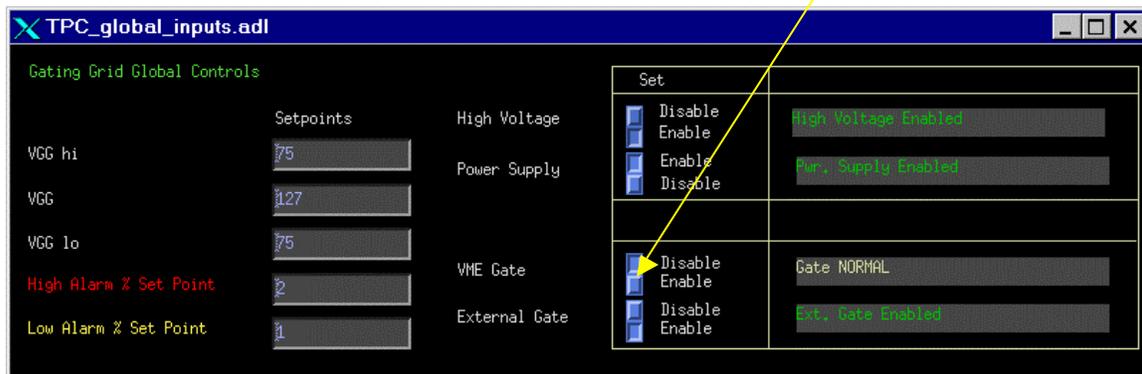
For special runs (ie laser) it is possible to run with the gated grid open all the time. If there is beam and the TPC anodes are on then it is necessary to keep this time to a minimum. To open the gate:

1. On the gated grid monitor GUI, click on the “expert controls” button. This pops up the expert window:

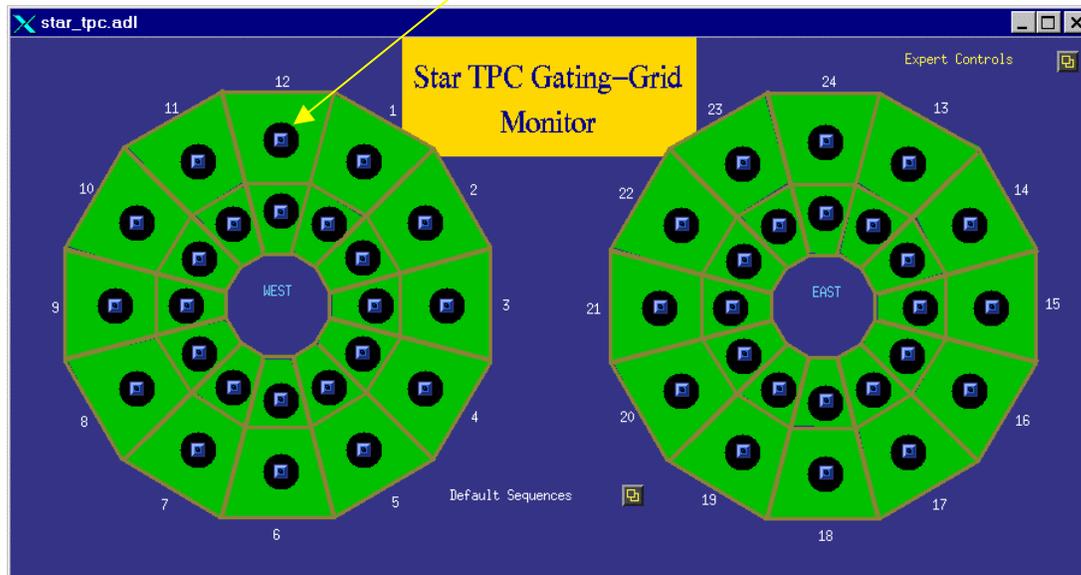


2. Click on the “Write Disabled” button - it will switch to “Write Enable” Then click on the “Global Control” button to open the global control window. (If not on, you can’t make changes to the GG settings.)

3. In the Global Control window, click on VME Gate Enable



The status will switch to “Gate Open” and the GG monitor screen will show black circles around sector buttons:



4. To return to normal running, reverse the process: In the global control window, click on VME Gate Disable, close the window; in the experts window click on the Write Enable button, and close the experts window.

TURNING OFF

1. On the gated grid monitor GUI, click on the “default sequences” button to open the auto sequences window.
2. Click on the “Grid Off” button and close the window. On the monitor window, all the sector color fields should turn red.
3. If it is anticipated that the TPC will be off for some time, turn off the GG driver crate (2A6-2).

TROUBLESHOOTING

Further troubleshooting hints are on the web. Go to the STAR homepage, then Group Documents ->TPC -> Operations. There are two files: Gating Grid Troubleshooting and Replacing Gating Grid Module.

VI. LASER

by Alexei Lebedev

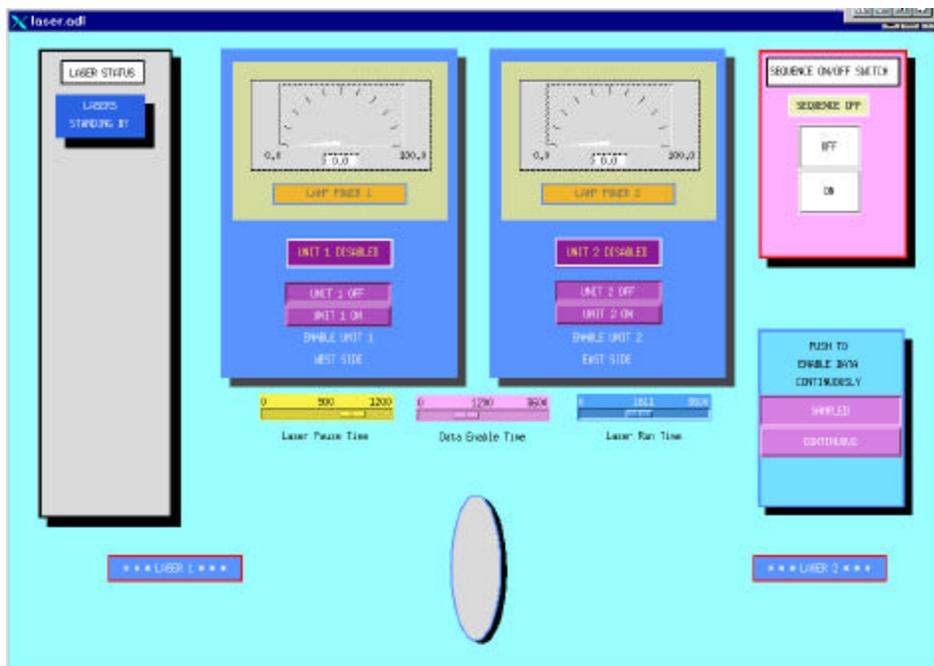
The TPC laser system consists of two separate lasers mounted on the first floor of the south platform. Each laser provides ~ 200 tracks in each half of the TPC, distributed throughout the drift volume. Each laser also “flashes” the opposite side central membrane, providing a distinct pattern of tracks from reflective stripes on the membrane. All these tracks are used to calibrate spatial distortions, and measure the TPC drift velocity.

A final run plan for using the lasers has yet to be determined. We will need to take laser runs from time to time and will also develop a method for running the cathode “closed loop”, i.e. with constant drift velocity.

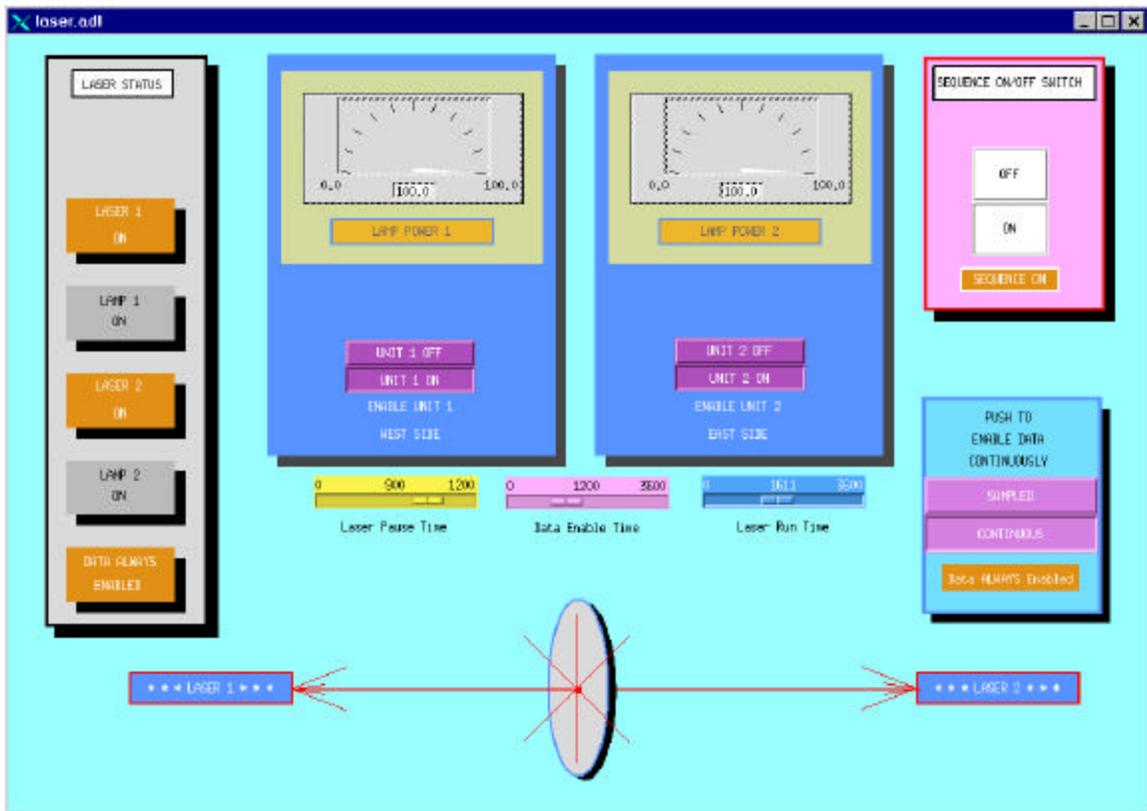
Laser # 1 is installed on the west side, laser # 2 on the east. To measure the drift velocity, use the EAST side laser (#2) with the gated grid OPEN. (See sections V. and IX.) To make a normal laser run, use both lasers with the gated grid “

Turning On the Laser:

1. Click on Desktop #7 and open the Interlock GUI. Check that the “Laser system Enabled” interlock light is green (= permissive ok.). If the light is not green, consult an expert.
2. Click on Desktop # 5. On the Top Level GUI, open the LASER window. This is the main Laser GUI:



- The lasers should be off. To make sure and to start properly, first click on the “Unit 1 Off”, “Unit 2 Off”, “Sequence Off” and “Sampled” buttons.
- Click on the “Sequence On” button. Wait ~ 10 secs then click on the “Unit 1 ON” button for laser #1 and “Unit 2 On” for laser #2. To run both lasers, both On buttons need to be clicked within ~ 5 secs of each other.
- Wait – the lasers go through a startup sequence. After ~ 20 sec yellow boxes should appear in the status window saying “Laser 1 On” and “Laser 2 On”. Shortly after that, two grey boxes will appear stating “Lamp 1 On” and “Lamp 2 On”. The lamp power meters should slowly ramp up to full power (100%). Symbolic red laser lights should appear at the bottom of the GUI. The display should look like:



- The laser needs to run for ~ 5 minutes before making a run or checking the drift velocity. The lasers self trigger at ~ 10 Hz.
- To prevent overheating and to preserve the lifetime, the lasers will shutdown after the time set by the “Laser run Time” slide bar. They will stay off for the time set by the “Laser Pause Time” slide bar. **These parameters can only be changed by experts.**
- To check the drift velocity, click on the “Continuous” button to enable continuous data sampling. Then see section IX.

TROUBLESHOOTING:

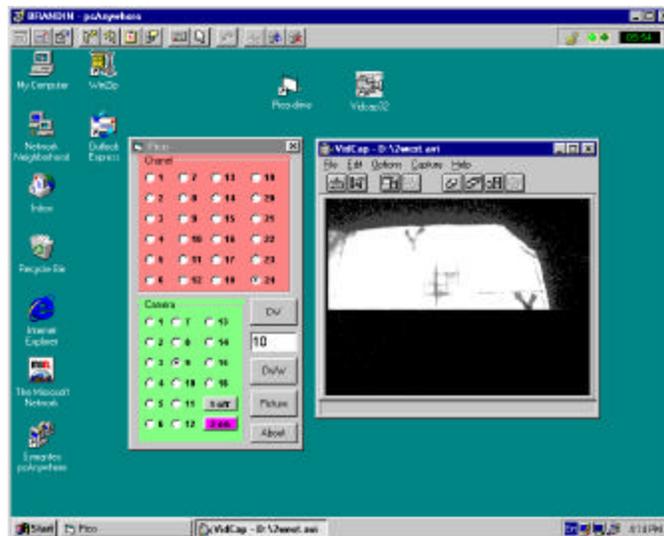
It is possible for full lamp power to be on and yet have the lasers not firing. There are a few cross checks you can make:

1. Look at the analog anode signal from Sector 3. This signal is available on an RG58 cable in the DAQ room labeled "Anode Sig, Plat 2A4". The cable is near the floor at the bottom of Rack DA3. The gated grid has to be OPEN, the cathode and sector 3 anodes must be on. If both lasers are firing, you should see evenly spaced (large) anode signals on the $\sim 5 \mu\text{sec/div}$ scale. Make sure this cable is not left grounded when you are done.
2. Make a normal laser run with DAQ and look at the events with the pad monitor. Laser events are easily recognizable.
3. For a normal laser run with level 3 trigger on you can also look at the level 3 online display.
4. Use the remote CCD cameras as described below.
5. For Laser problems call Alexei Lebedev first, then a TPC expert.

REMOTE VIEWING

The laser controls are mounted in Rack 1A9 on the south platform, including a PC (BRANDIN.STAR.BNL.GOV, 130.199.88.219). This PC is connected to piezoelectric drivers for steering the laser beams (experts only) and to CCD cameras for viewing the laser spot. To see the laser spots (and confirm that the laser is firing):

1. Logon to ASTAIRE.STAR.BNL.GOV (located in the control room) as Username: startpc.
2. To access the remote PC (BRANDIN), double click on the "Symantec pcAnywhere" icon on the desktop. When the pcanywhere window opens, make sure the "Remote Control" button is selected and then double click on the "Network" icon.
3. Select the host BRANDIN and click on "OK". This will bring up the viewing window:



4. The Green “Camera” window allows one to select different CCD cameras: 1 & 2 are for the East laser (Unit 2), channels 9 & 10 are for the West laser (Unit 1) and Channel 16 shows the control box for the west laser. All other channels are inactive. Note that Button 2 should be on, button 1 off. Don’t change these settings.

5. The red channel window is for the piezoelectric drivers and is for experts only.

6. The CCD image will be shown in the Vidcap window. The image shown is the laser spot. The sync between the PC’s and the camera is slow so the image comes and goes. You can change the contrast and brightness by selecting “Video Source” under the “Options” pull down menu.

7. Sometimes the Vidcap window freezes. To check if the window image is “alive”, go to channel 16 – the image of the control box. If it appears dead, click on the image. A live image will have a slightly changing brightness and the borders will be ragged.

TURNING LASERS OFF

1. If you are running the cathode “closed loop”, open the loop on the cathode control panel. Also, switch the gated grid back to “Normal” on the gated grid control window.

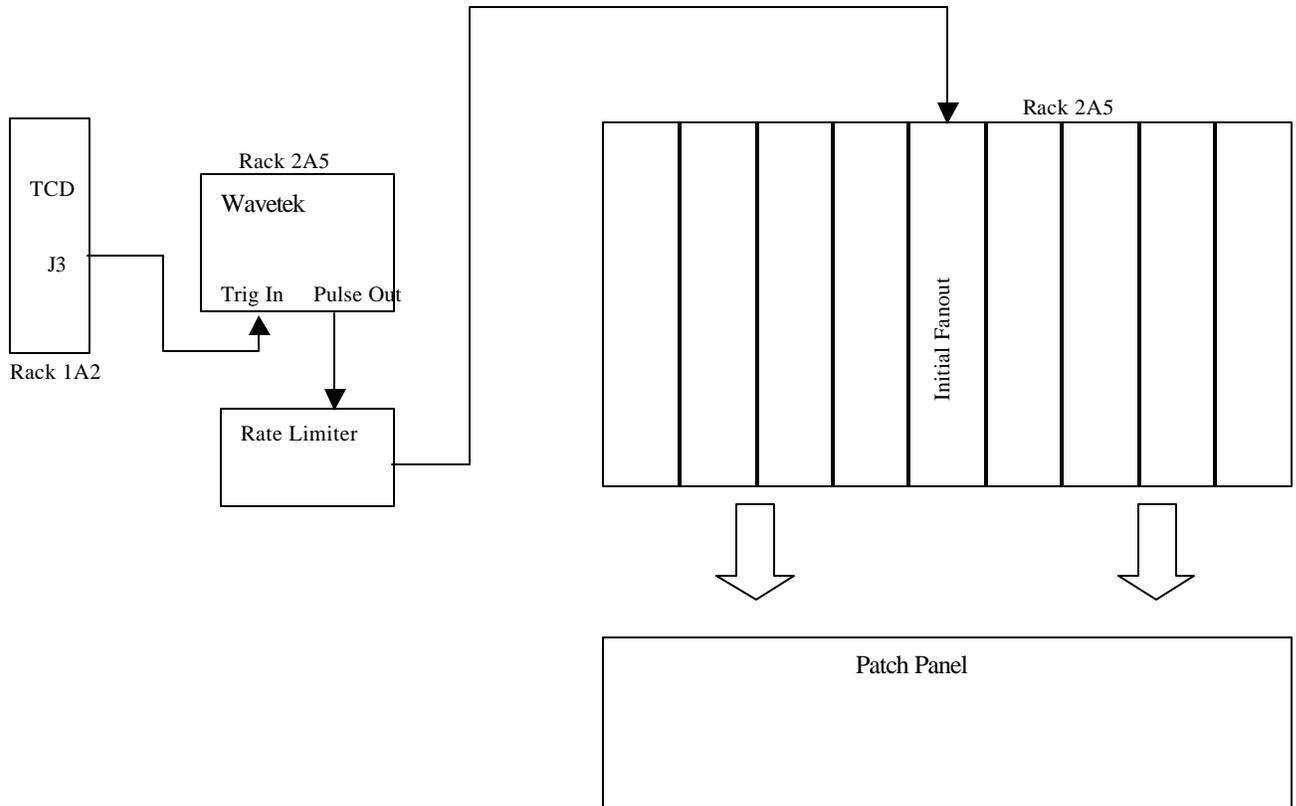
2. On the laser control window, click on “UNIT 1 OFF”, “UNIT 2 OFF”. Lamp power will go down to 0.

3. At this point, click on Sequence “OFF” button and the data “Sampled” button.

4. Close the control window.

VII. GROUND PLANE PULSER

A system is in place to pulse the TPC sector ground planes, inducing a signal on all pads simultaneously. This allows study of FEE electronics, channel-to-channel gain variation and timing offsets (t_0). The heart of the system is a Wavetek pulse generator located in Rack 2A5. The pulser is triggered from the TPC TCD (output J3) located in Rack 1A2. Schematically:



The rate limiter is an external box sitting inside the rack – it has its own power (AC to DC converter). It prevents the pulser fanout modules from being over driven and burning up. It will cut off any input over ~ 800 Hz. From the rate limiter, the pulse goes to the middle fanout unit in the top crate in Rack 2A5. Each output from this fanout drives each of the other fanouts in the crate. For the TPC there are a total of 72 separate outputs (8 modules with 9 outputs each). The outputs from the fanouts go to a patch panel and then to the TPC. To get the proper termination, each outer sector needs 2 cables and each inner sector needs one.

WAVETEK SETTINGS:

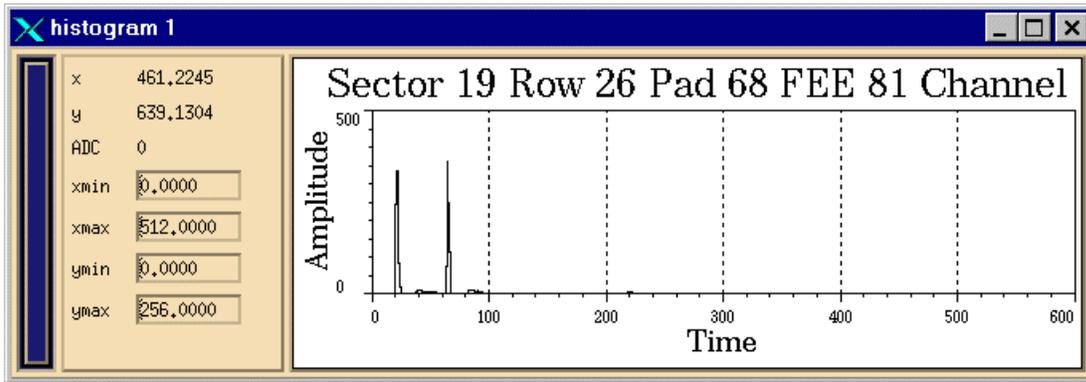
Currently (4/18/00), we are using an arbitrary waveform which has been downloaded to the Wavetek and is stored in memory. The Wavetek has been programmed so that this arbitrary wave form (labeled "Laser") is the default pulse (ie, after a power outage, the Wavetek will power up with this pulse ready to go – theoretically!) This pulse was downloaded by Fabrice Retiere last year and is

essentially a square wave pulse with a slightly rounded rising edge. We are currently unable to download pulses – the slow controls interface needs additional work. The parameters for the “Laser” pulse are:

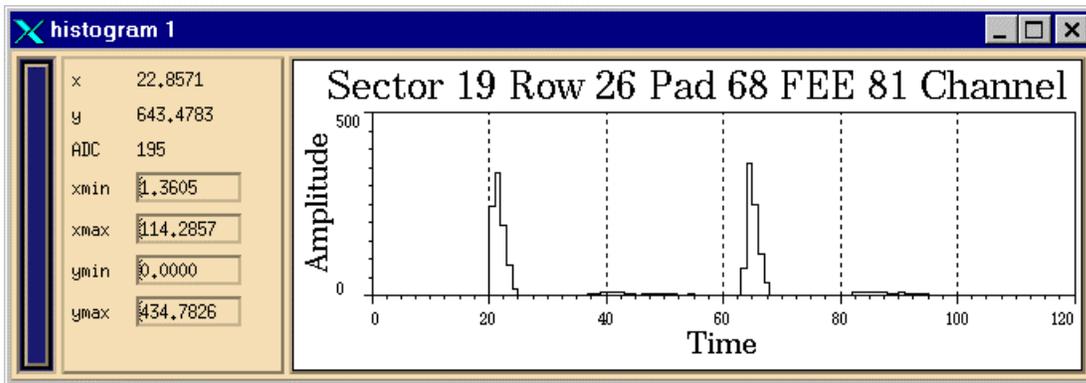
Amplitude 200 mV
Ampl after fanout 3.6 V
Offset 0.0 V
Mode: Trig'd, cnt: 0000001
Freq sample period: 100 nsec
Pulse width 1.22 μ sec
Trigger Source: EXT
Trigger Slope: Pos
Trigger level: +.20 V
Trigger Period 10.000 msec (irrelevant)
Filter: Off

MAKING A PULSER RUN:

The pulser is usually in ready state for a data run (see troubleshooting below). DAQ or ONLINE just needs to initiate a pulser run and take the requested number of events. The pulser will be triggered automatically via the TCD. On the pad monitor, the pulser looks like:



There are two pulses because, depending on the run mode, the pulser can be triggered twice. A normal run should only have one pulse. Expanded:



The “hash” after each pulse is due to overshoot of the initial pulse.

PULSER TROUBLESHOOTING:

Possible reasons for not seeing the pulser in the data:

1. Wavetek not being triggered – make sure DAQ is set up for a pulser run. If an access is possible, look for trigger pulses out of the TCD in conjunction with DAQ.
2. Fanout crate is off or inhibited – check that VME crate in Rack 2A5 (GP-pulser) is on and voltages are correct. Also, for historical reasons, the pulser crate uses the same inhibit signal as the gated grid crate. (Inhibit signal is on a DB15 cable that plugs into the front of the crate.) Make sure the gated grid permissive is on.
3. Rate limiter is smoked – need an access to see if pulse comes out of Wavetek but not out of the limiter. Replace limiter.
4. Wavetek in funny state – the Wavetek can occasionally revert to a default sine wave pulse (or whatever). It is possible to remotely cycle the AC power for the Wavetek using the remote power switch. (See that section of this manual.)
HOWEVER: This should only be done after consulting a TPC expert!
5. Wavetek is on but still no pulse out – check the “main out” push button near the pulse out BNC connector. The green LED should be on.
6. Some sectors have pulser, some don't – likely a fanout module has blown a fuse. Replace the module.

VIII. REMOTE AC SWITCH

NOTE: As of 5/5/00 the remote power switch is not answering! See page 234 of the logbook.

There is a remote AC power switch mounted in Rack 2A4 that allows an operator to turn on/off up to 8 devices. The outputs are grouped by 4's, each grouping sharing 15 amps. Even though the current is shared, each of the 8 outputs can be turned off independently. We are currently using three outputs:

1. Glassman cathode HV power supply
5. Wavetek pulse generator
8. FEE manifold temperature computer

To address the power switch:

1. Telnet to rps1.star.bnl.gov (130.199.89.26)
2. Password:
3. On log in, the status display is shown:

Network Power Switch v2.01 Site: STAR @ RHIC

Plug	Name	Status	Boot Delay	Password	Default
1	Glassman_HV	OFF	15 sec	(none)	ON
2	(none)	OFF	10 sec	(none)	OFF
3	(none)	OFF	10 sec	(none)	OFF
4	(none)	OFF	10 sec	(none)	OFF
5	Wavetek_AW	ON	10 sec	(none)	ON
6	(none)	OFF	10 sec	(none)	OFF
7	(none)	OFF	10 sec	(none)	OFF
8	Temp_Computer	ON	30 sec	(none)	ON

"/H" for help.

Communication Settings: 9600,N,8,1

Modem Init. String: ATE0M0Q1&C1&D2S0=1

Modem Disc. String: (none)

MAC Address: 00-40-05-70-ac-55

IP Address: 130.199.89.26 Disconnect Timeout: 15 Min

Subnet Mask: 255.255.254.0 Command Echo: On

Gateway Address: 130.199.88.24 Command Confirmation: On

4. Typing /H gets the help screen. To turn channel n off, type /off n.
To turn on, type /on n

5. To logoff, type /X. If you don't log off, it will disconnect automatically after 15 minutes.

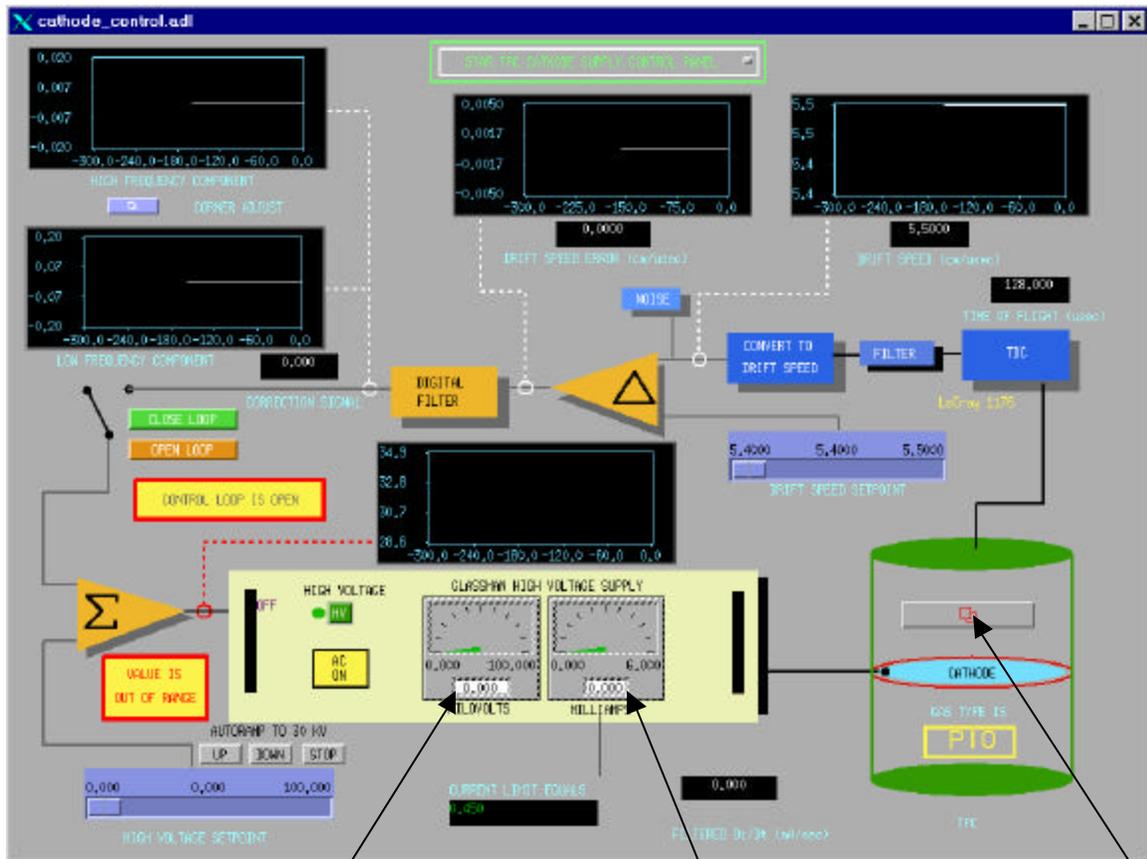
NOTE: POWERING OFF ANY OF THESE DEVICES SHOULD ONLY BE DONE AFTER CONSULTING A TPC EXPERT.

IX. CATHODE & FIELD CAGE

The high voltage for the TPC drift field is supplied by a Glassman power supply located in rack 2A3. The TPC can be run in two modes: fixed E field (constant voltage) or fixed drift velocity (variable voltage under computer control). The full voltage of the power supply (typically 31 kV) is applied to the central membrane. A uniform drift field is supplied by four resistor chains (inner field cage, east and west; outer field cage, east and west.). To monitor the field cage performance, a scanning DVM measures the DC current in each resistor chain and any current on the outer ground shell. In addition, the DVM measures the voltage on the next to last and last stripes for each end of the inner and outer field cage. These voltages are adjusted to properly terminate the drift volume. The DVM scanner is located in Rack 2A3. The VME crate for the cathode HV power supply is in Rack 2A3, while the VME crate for the scanner control is in Rack 2A4 (FCC).

TURNING ON THE CATHODE (CONSTANT VOLTAGE)

1. Select desktop #2 (Cathode/Field Cage).
2. On the top level GUI, click on the cathode icon and on the field cage icon.
 The cathode control GUI is used to control the Glassman, while the field cage GUI is used to monitor the resistor currents and the stripe voltages. The cathode control GUI looks like:



Voltage Readback

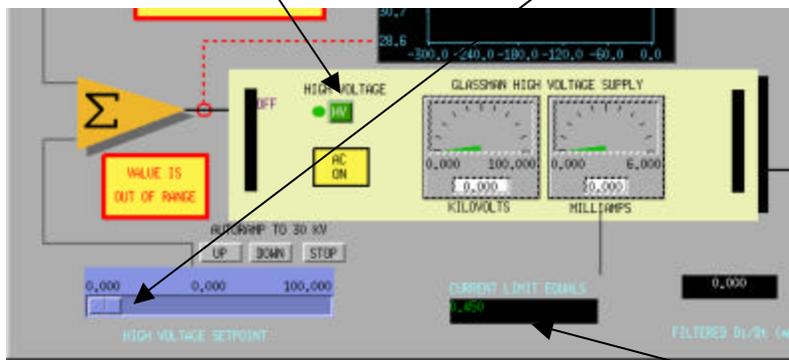
Supply Current
Readback

Interlock reset
button

3. First, check the interlock. Select Desktop #7. Open the Interlock GUI. The “Cathode Enable HV” output should be green and not flashing. If so, proceed. If not, call an expert.
(For the cathode, the interlock goes directly to the Glassman, not to the VME crate.)

Note: If there has been a gas alarm and the interlock has dropped out it will latch off. It will be necessary to go out to the gas mixing room and re-enable the interlock if the gas system has recovered. In this case, when opening the cathode GUI, the message “check interlock” may come up. Click on “reset interlocks” and close the interlock window.

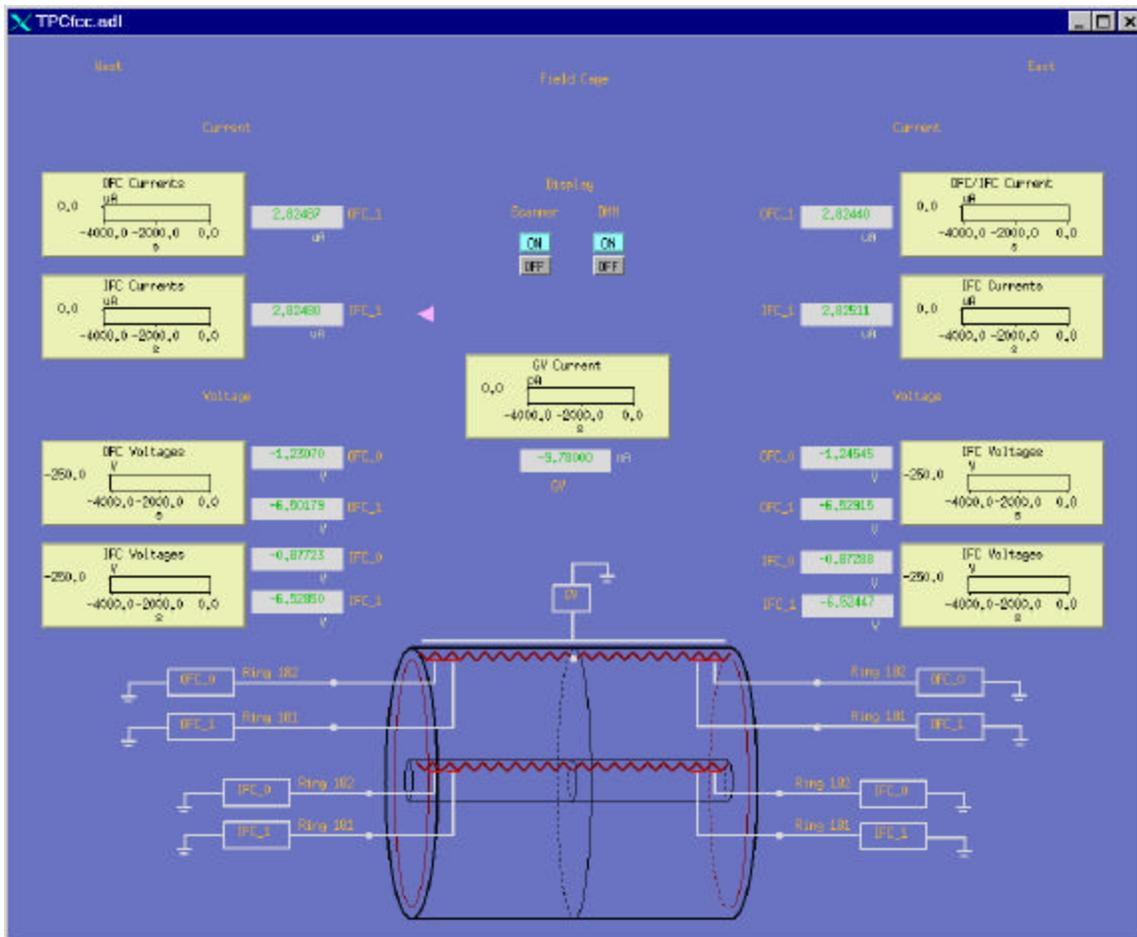
4. Go back to desktop #2. If the cathode GUI is showing “AC off” then turn the AC power on using the remote power switch (section VIII). Note that it is NOT possible to switch the AC using the cathode GUI – it only indicates the status.
5. Once the AC is on, first make sure the HV setpoint slider bar is set to 0.0. Then click on the green HV button.



The HV should switch to “on” and show a red “LED”. Also, check that the current limit equals 0.450 mA.

NOTE: It is NOT possible to turn the HV back off using the HV button. This is true of both the GUI AND the actual supply itself. The only way to turn the HV off is to switch off the AC.

6. Raise the cathode HV to 1000 V. You can either click and drag the slider bar button to the right (SLOWLY) or just single click to the right of the button to raise the HV 100 volts a click.
7. Check that the voltage readback window reads ~ 0.965 kV (There is a constant DC voltage shift of ~ -35 volts.) Also check that the current readback window reads .004 to .007 mA.
8. Now click on the field cage GUI window. It should look like:



- If the scanner is working properly, the readings for each current and voltage should update every few seconds. The pink cursor shows the current reading.
- Check that the four field cage currents read $\sim 2.825 \mu\text{A}$. If not, set the voltage back to 0 and call a TPC expert.
- Reselect the cathode control window and click on the autoramp “up” button above the slider bar. This will automatically ramp the voltage up to 30 kV. It is recommended that you stop the autoramp (push “stop”) at 10 and 20 kV to check the currents and voltages. See table below for standard readings.

NOTE: The resistor chain currents are a very sensitive measure of possible field cage corona and breakdown. Corona that develops on the outer field cage shows up as a loss of current in one of the resistor chains and a corresponding increase in the ground shell current (GV). Corona will show up at the level of 20 nA and increase \sim linearly with voltage until the field cage sparks (NOT a desirable occurrence!). The cathode HV should be set to 0 by pushing the “autoramp down” button immediately if ANY of the field cage currents deviates from the normal values. If the autoramp doesn’t work, slowly reduce the voltage with the manual GUI slider bar. If THIS doesn’t work, use the remote power switch (Section VIII) to turn off the Glassman or go to the gas mixing room and push the “Cathode HV Off” button on the TPC interlock panel.

- After the autoramp up is finished, slowly raise the voltage to the canonical value (31 kV as of 4/18/00). The Glassman current readback should be $\sim 0.338 \text{ mA}$. Again check the resistor chain currents and stripe voltages.

STANDARD FIELD CAGE CURRENTS AND VOLTAGES (12/12/99)

	5 kV	10 kV	15 kV	20 kV	25 kV	30 kV	31 kV
OFC West	13.769	27.429	41.098	54.250	68.401	82.072	84.793
IFC West	13.772	27.433	41.102	54.758	68.410	82.081	84.806
OFC East	13.769	27.429	41.095	54.750	68.399	82.068	84.793
IFC East	13.771	27.433	41.102	54.758	68.410	82.082	84.806
Shell	~0	~0	~0	~0	~0	~0	~0
OFC_0 West	-6.06	-12.09	-18.07	-24.07	-30.05	-36.05	-37.25
OFC_1 West	-31.69	-63.15	-94.56	-126.21	-157.64	-189.11	-195.38
IFC_0 West	-4.27	-8.51	-12.75	-16.98	-21.22	-25.46	-26.30
IFC_1 West	-31.77	-63.21	-94.81	-126.32	-158.06	-189.63	-195.93
OFC_0 East	-6.06	-12.07	-18.09	-24.10	-30.11	-36.13	-37.33
OFC_1 East	-31.77	-63.22	-94.78	-126.53	-158.05	-189.60	-195.88
IFC_0 East	-4.27	-8.50	-12.74	-16.97	-21.20	-25.44	-26.28
IFC_1 East	-31.76	-63.30	-94.81	-126.31	-158.06	-189.63	-195.92

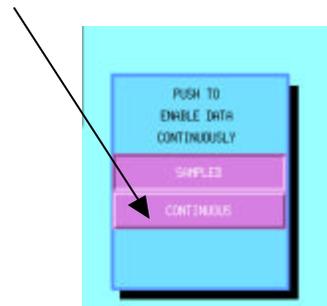
Note 1. The absolute values of the currents can vary with temperature and humidity in the hall. Again, it is important to look for any one current deviating (1 part or more in 1000) from the norm.

Note 2: If the magnet is on, the shell (GV) current readout is useless due to noise pickup.

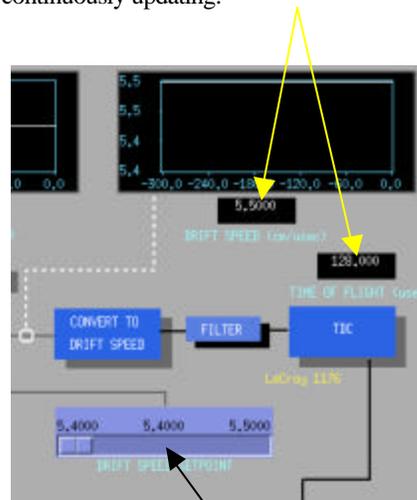
RUNNING CLOSED LOOP (CONSTANT DRIFT VELOCITY)

The cathode control program is set up to run in “closed loop” mode where the HV is adjusted automatically to maintain a constant drift velocity. The program uses a measured drift time derived from a start signal generated by the laser and a stop signal from an anode wire. Currently, the final method for using this capability has not been decided upon, but the following is an outline for operating the cathode closed loop.

1. Power up the EAST end laser. (Section VI). Light from the east end laser is reflected off a mirror on the west end and flashes central membrane. This generates a “charge sheet” that drifts to the west end anodes and is detected by a preamp mounted on Inner sector 3.
2. Open the gated grid. (Section V)
3. The cathode should already be set at 31 kV and the Anodes must be at operating voltage. (Section X).
4. Select desktop # 5 and open the laser control panel. If not already enabled, click on the “continuous” button to enable the readback data:



- Go back to desktop #2 and check that the program is measuring time of flight. The time of flight and drift speed windows should be continuously updating:



If they are not then recheck the laser, gated grid, and anodes. As an additional diagnostic, the wire signal from the anode is available on a BNC cable in the DAQ room (bottom of Rack DA3, labeled “Anode Sig, Plat 2A4). This signal can be looked at on a scope BUT IT SHOULD NOT BE LEFT GROUNDED IN THE DAQ ROOM! If the laser is firing and the gated grid is open, large wire signals should be apparent.

- If the time of flight is being measured, set the desired drift velocity with the slider.
- Click on the green “close loop” button. The GUI switch will close and the program should start to adjust the HV while seeking the setpoint drift velocity. Watch the strip charts to see if it converges.

NOTE: The program has built in limits that prevent the HV from going too high. However, safety dictates that the operator should NOT leave this process unattended!

- After the drift velocity is set, click on the orange “open loop” button. The loop should open and the power supply should stay at that voltage.
- Turn off the laser and return the gated grid to normal.

HIDDEN PARAMETERS

- As part of the closed loop measurement and feedback process, there are a few control parameters that can be adjusted. **THIS IS FOR EXPERTS ONLY!**
- To access these parameters, click the magic button:



3. As of 4/18/00, the parameters are:

hidden_panels.adl

RESTART medm AFTER RANGE OR GAS CHANGE

0,000 0,990 1,000
TOF Filter Adjust

0,000 0,000 1,000
Di/Dt Filter Adjust

0,000 0,400 0,800
Digital Filter Gain Adjust

0,000 0,450 6,000
CURRENT LIMIT SETPOINT

IT TAKES ABOUT 5 SECONDS TO CHANGE GASES IN DATABASE

GAS TYPE

Enable
Reset
Glassman
HV Enable

34,747 kV
UPPER RANGE LIMIT

0,000 31,588 100,000
HIGH VOLTAGE RANGE CENTER

28,429 kV
LOWER RANGE LIMIT

0,050
0,000
-0,050
-300,0 -240,0 -180,0 -120,0 -60,0 0,0
time (sec)

0,000 0,000 0,050
AMPLITUDE

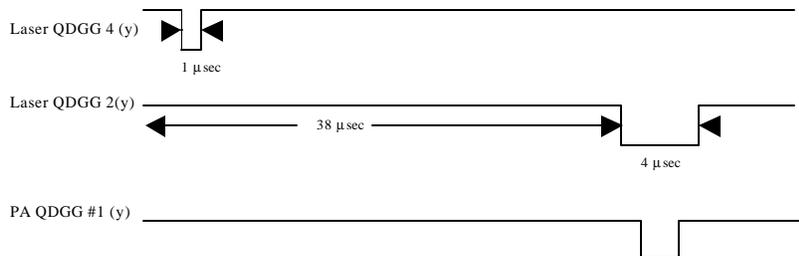
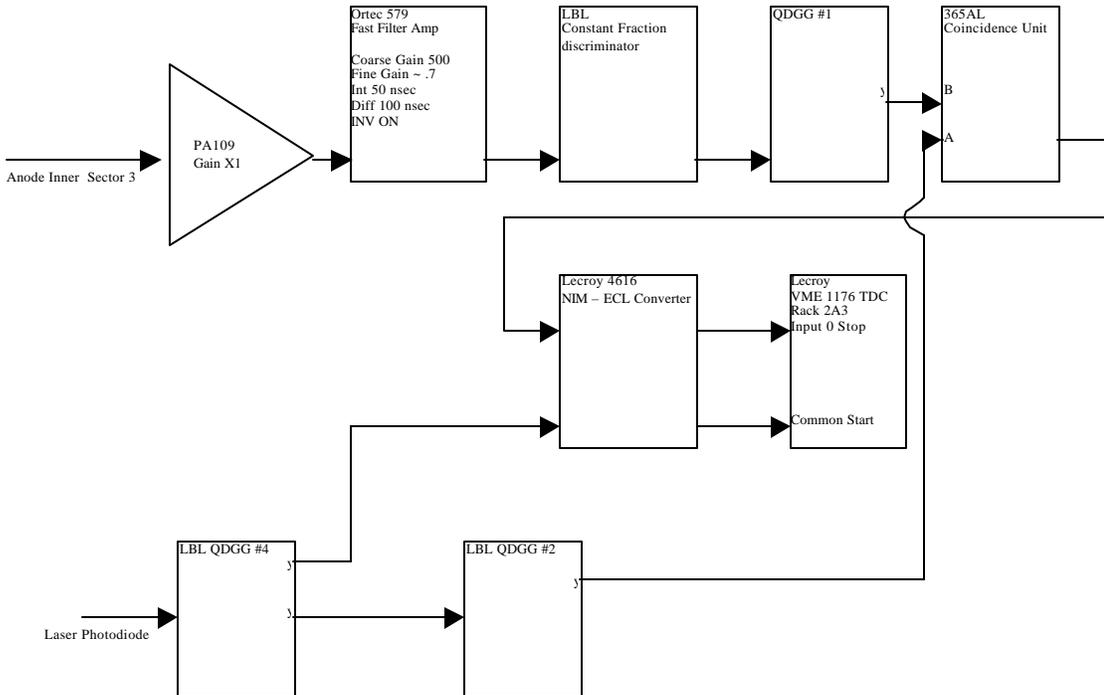
0,001 0,001 0,020
FREQUENCY

COUNTER 23551

NOISE GENERATOR

DRIFT TIME BLOCK DIAGRAM

To supply the start and stop signals for the closed loop drift time measurement there is some NIM logic implemented in Rack 2A4. The start signal comes from the laser photodiode and the stop signal from the anode wire. To select only the signal from the central membrane (drift ~ 39 μsec), gate generators are used along with a coincidence unit. The schematic looks like:



TURNING OFF

1. To turn the cathode HV off, click the autoramp “down” button above the HV setpoint slider bar. The voltage will ramp down to 0 (takes ~ 10 minutes).
2. If the TPC will be off for some time, use the remote power switch to turn off the Glassman or go to the gas mixing room and drop the cathode HV interlock. (Push the red “Cathode HV Off” button it will flash red.)

X. ANODES

OK, right up front, the most important thing with the anodes is:

PATIENCE

This won't be the last time I tell you. In addition to the normal care one needs to take with MWPC, the slow controls program for the anodes really IS slow. If you try and do multiple commands or not wait for one step to finish, it will crash and burn for sure. So... here we go:

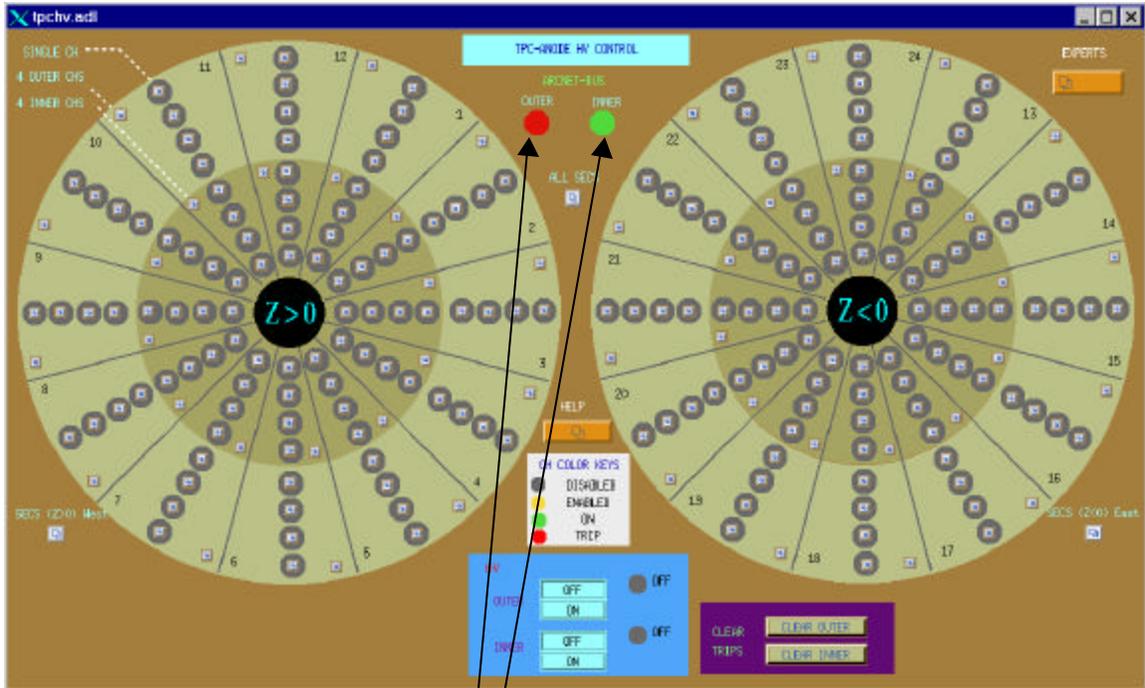
The HV MWPC for the TPC (anodes) is supplied by Lecroy 1471 HV cards. Each sector is segmented into four sections, each with its own independently settable HV. The Lecroy crates for the HV supplies are in Rack 2A7 (Outer sectors in the upper crate, inner sectors in the lower crate). Each Lecroy 1471 card has eight independent outputs and supplies two sectors. The Inner sections are numbered from 1 to 4 (1 = innermost radius) and the Outer sections from 5 to 8 (8 = outermost radius). The HV is controlled by a VME processor which talks to the crate via an ARCNET interface. There is a separate CPU for the inner and outer sectors. The inner CPU is in Rack 2A7, the outer in 2A6. In addition, one can communicate with the Lecroy crates independent of VME using a serial connection. (see below for details.)

COLD START

1. After a complete shutdown, the crates may be completely off. Also, after replacing a HV card it will be necessary to do a cold start. The main AC switch for the Lecroy crate is in the back. Turn this on (Both crates).
2. On the front of the crate, turn the key to "remote". (Both crates.)

WARM STARTUP

1. If the Lecroy crates are on and in remote, first check the interlock. Select Desktop # 7 and bring up the Interlock GUI. Check that the "Anode HV Enabled" button is green and not flashing. If not, contact a TPC expert or check the TPC Interlock manual.
2. Select Desktop # 8 and bring up the VME status GUI. Make sure the two VME crates are on (2A7 ANHV/Interlock for the Inner and 2A6-3 ANHV-2 for the Outer)
3. Select Desktop #1 and bring up the Anode Voltage GUI. It looks like this:



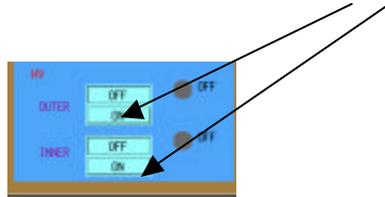
4. Check the ARCNET bus status . Are they red? (Probably). If so you need to reboot the VME processors.
5. On the desktop, click on the Exceed shortcut "sc.session.xc".
6. At the sc prompt, type **telnet scserv 9013** (Outer sectors). This will bring up a terminal session for the VME processor. Type **CR** to get the prompt, then type **reboot**. Reboot takes ~ 5 minutes. If the processor is working properly, the ARCNET status light will turn green and debug messages will appear in the session window. (Typical messages are STARCNET: reply LS and RC_MC:RC S2 MC) These are normal. For normal running, leave this session window up – you'll need it to reboot from time to time.
7. For the Inner Sectors, repeat step 6 except **telnet scserv 9006**. Leave that session window up also.
8. The status for each channel (1 channel = 1 section of one sector) is indicated by the color circle around its access button:



9. The color code for the status is shown on the GUI:

- White: The VME processor is dead or the VME crate is off.
- Grey: Channel is disabled. Even if the HV is turned on and you set a demand voltage for this channel, nothing will happen.
- Yellow: Channel is enabled but HV is off or < 10 Volts. **Note that a channel can be enabled even if the HV is OFF.**
- Green: Channel is on at some voltage greater than 10 volts.
- Red: Channel has tripped off due to excess current draw.

10. Check that the status of ALL channels (inner and outer) is disabled (grey.)
11. Turn on the HV for each crate by clicking on the “HV on” buttons in turn.

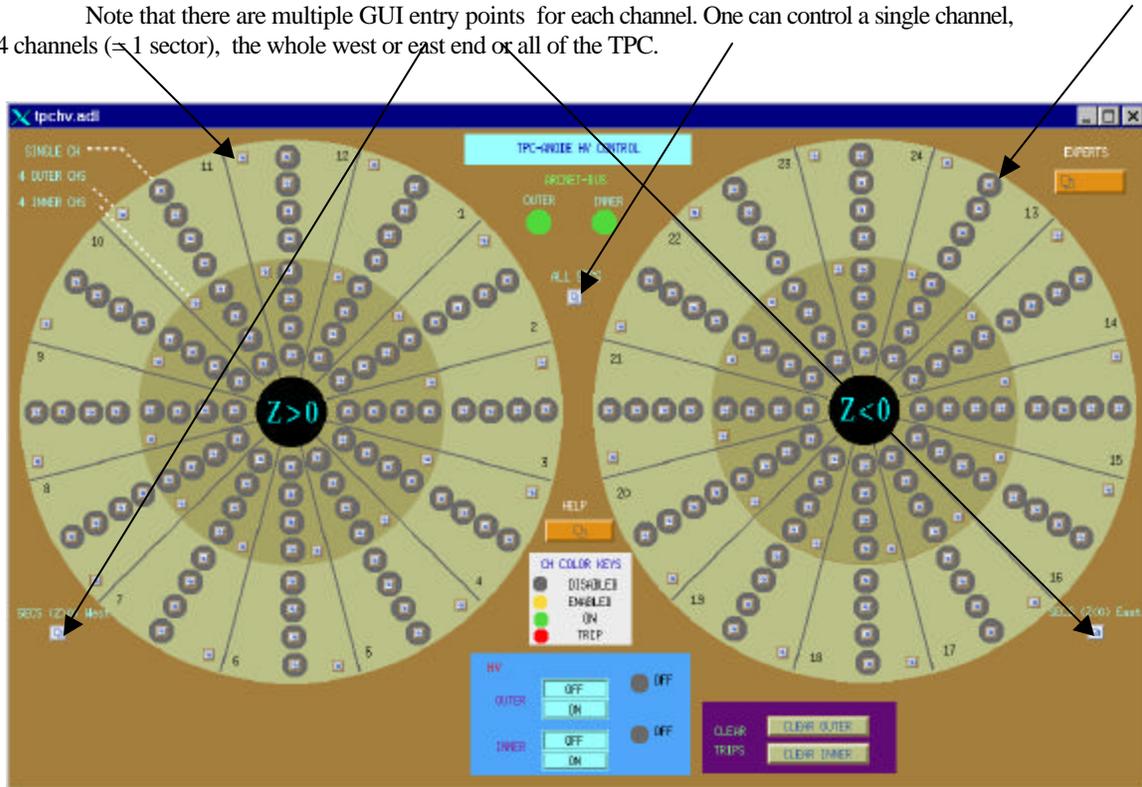


The HV status should turn from off to on and the light will turn green. (Wait for it!).

A TOUR OF THE CONTROL WINDOWS

At this point the system is ready to apply HV to the sectors.

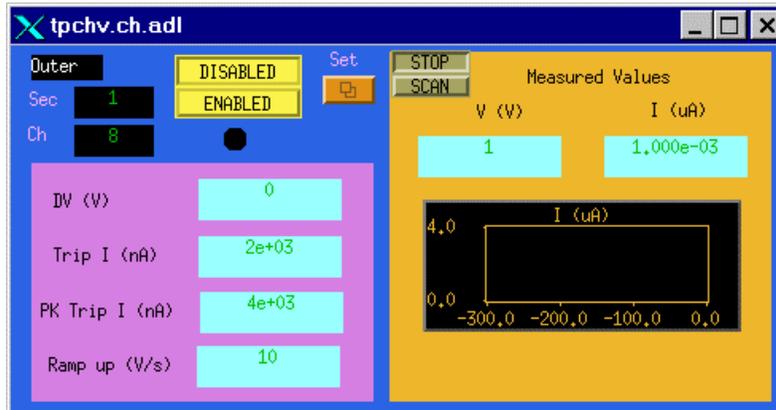
Note that there are multiple GUI entry points for each channel. One can control a single channel, 4 channels (⇒ 1 sector), the whole west or east end or all of the TPC.



SINGLE CHANNEL

The single channel window would typically be used to reset one tripped channel or to monitor a channel that was drawing current.

1. On the top level GUI, click on a single channel button. This brings up the monitor window for that channel:



All of the windows on this screen are output values. The demand voltage (DV) is shown in the first window. The next two windows show the database values for the trip current and peak trip current. A channel that draws current above these levels will automatically trip off. The trip current has a time constant of ~ 10 msec, the peak trip current ~ .75 msec. As shown the limits are set to Trip current = 2.0 μ A, PK trip = 4.0 μ A.

NOTE: These limits are set purposefully low in order to protect the MWPC's. They will be adjusted after we see what the RHIC operating conditions are.

THESE LIMITS CAN ONLY BE CHANGED BY EXPERTS!!! NO EXCEPTIONS.

The Ramp up window shows the current value for the rate at which voltage is applied to the chamber. It should always be 10 V/sec.

The windows on the right show the readback parameters for this channel (Volts and Current) along with a strip chart of the current. The "Scan" button is used to force the program to read this channel more often. It can be used when the window is active, but click stop before closing the window.

To enable this channel ONLY, click on the "Enabled" button. The status light just below the button will turn to yellow (for demand voltage = 0) or green (for demand voltage > 40 V) or red (tripped).

2. To input a demand voltage for this channel, click on the "Set" button. This brings up the single channel control window:

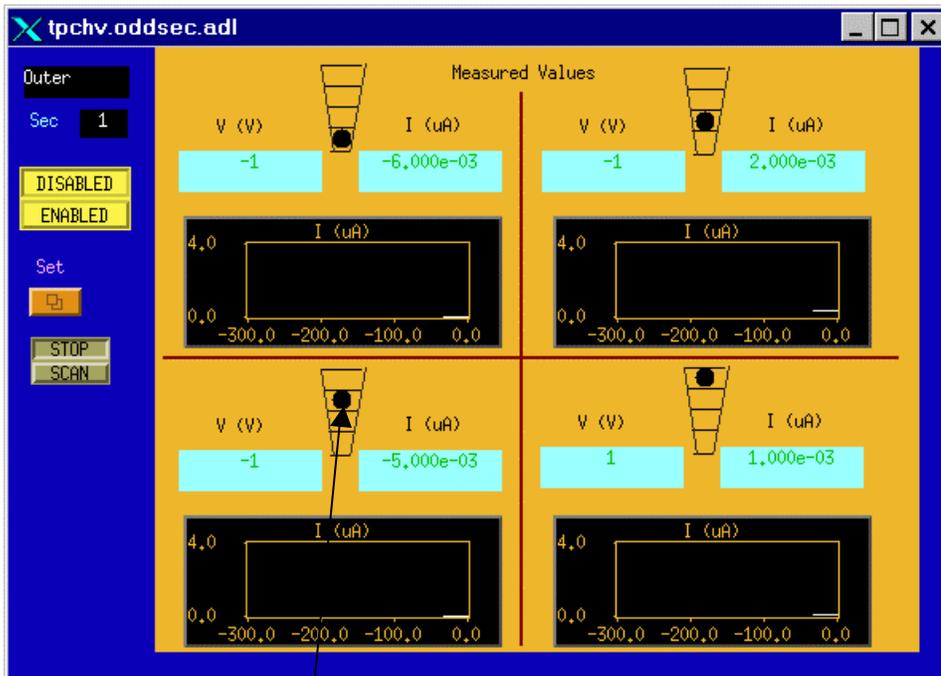
- To set a demand voltage for this channel, type a value in the DV window and hit return. (Note: The mouse pointer has to be on the window to input a value).
If the channel is enabled and not tripped, the voltage will ramp up to the demand value.

AGAIN, EXPERTS ONLY FOR THE OTHER THREE WINDOWS!

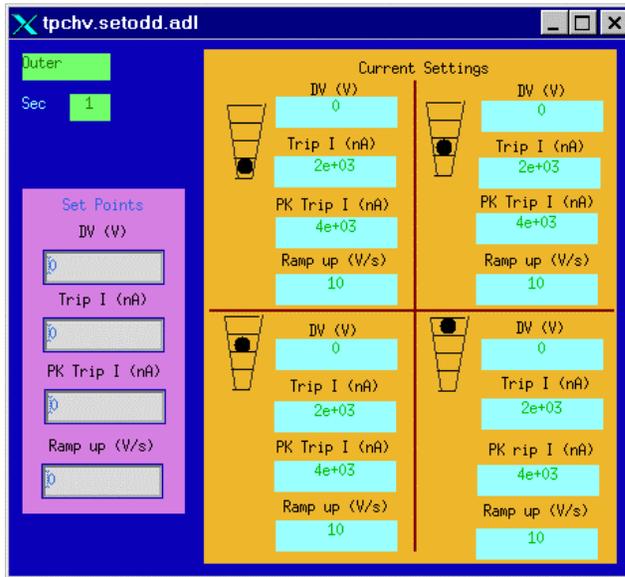
4 CHANNELS OR 1 SECTOR

This window would typically be used to reset a sector if more than one section tripped or to lower the voltage for one sector.

- On the top level GUI, click on one of the sector buttons to get the monitor screen:



Here each section of the sector has the voltage, current and current stripchart displayed. The status of each section is also indicated. To input a demand voltage FOR THE WHOLE SECTOR, click on the "Set" button. This brings up the control window:

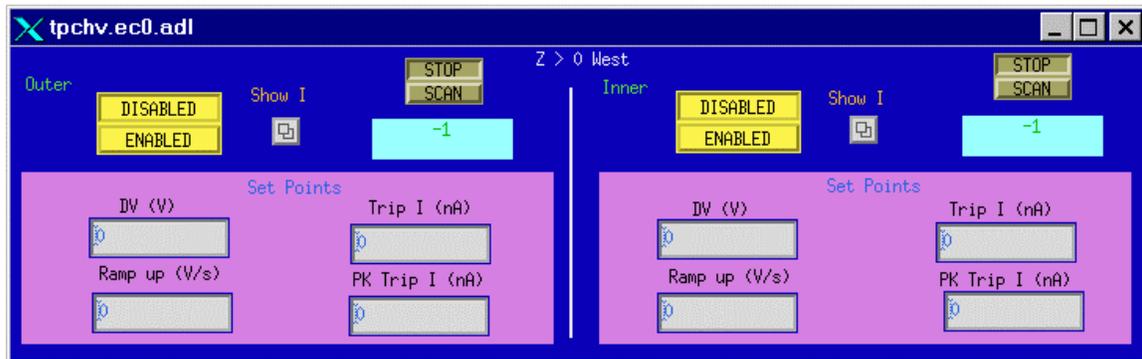


As for the single channel window, set a demand voltage by typing in the DV set point window and hitting CR. Do NOT type anything in the other three windows.

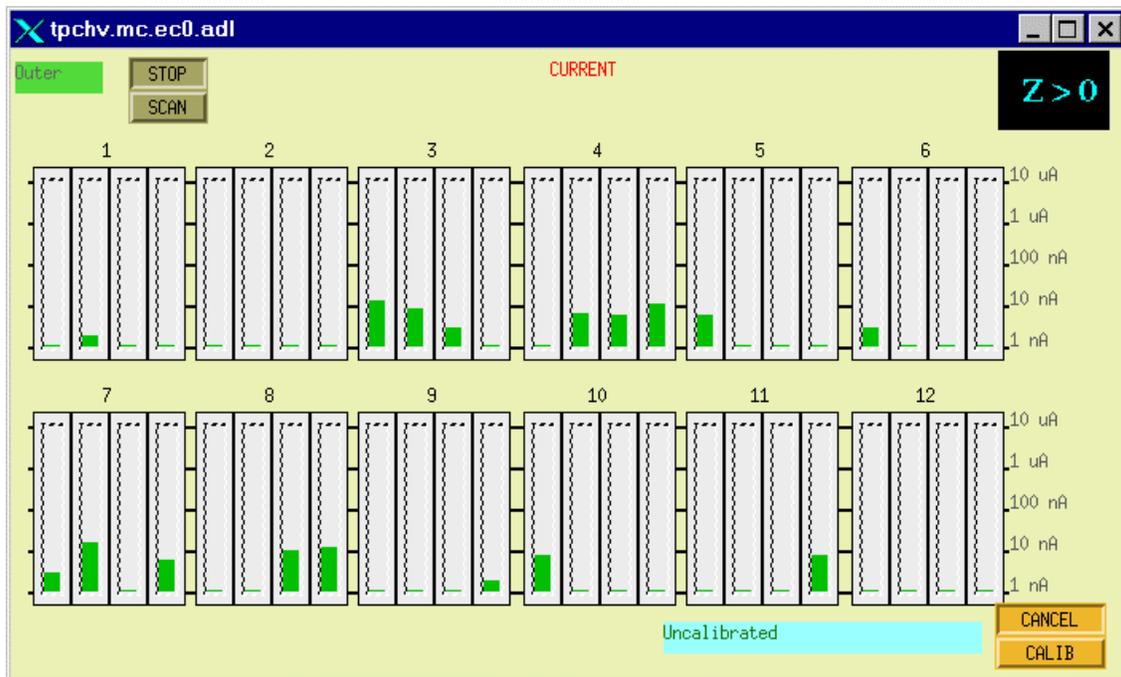
EAST OR WEST END

These windows are used to control one whole end of the TPC (12 Inner & 12 Outer Sectors)

1. On the main Anode window, click on the “SECS (Z>0) West” or SECS (Z<0) East button to bring up the control screen:



The “Enabled” button will now enable all sectors on that end. To raise the voltage, input the demand value into the Set Point DV window. **NOTE: This will raise the voltage on ALL sectors of that end.** To see the current for the Inner or Outer sectors, click on the corresponding “Show I” button:

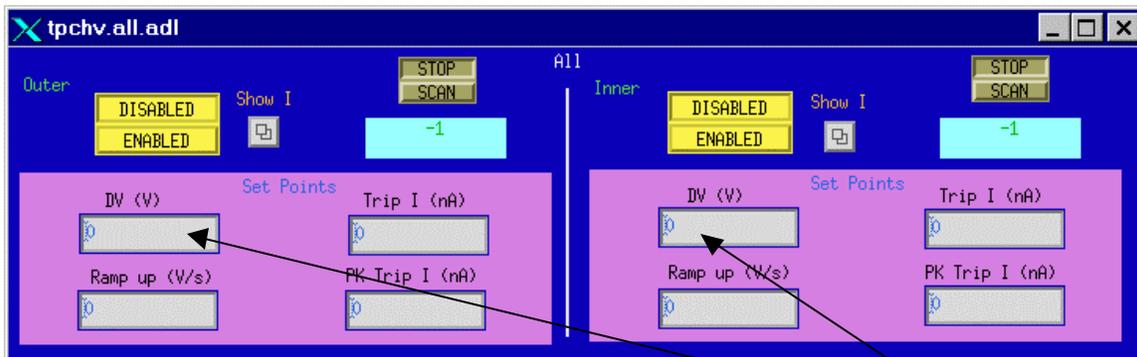


This shows the uncalibrated current for all sections of the 12 outer sectors of one end (log scale). The Lecroy modules have varying levels of DC current offsets – to do a calibration, see below.

RAISING THE VOLTAGE (WHOLE TPC)

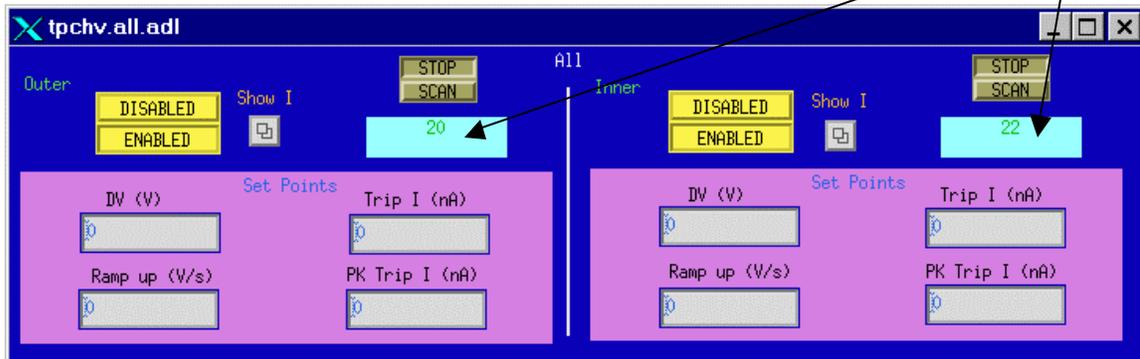
This is the window and method that is normally used to bring the TPC MWPC's to operating voltage.

1. On the top level Anode GUI make sure both ARCNET lights are green. If one or both are not, reboot the corresponding processor and do the Warm Startup Procedure (see above).
2. On the top level Anode GUI, click on the “All SECS” button to bring up the control window:

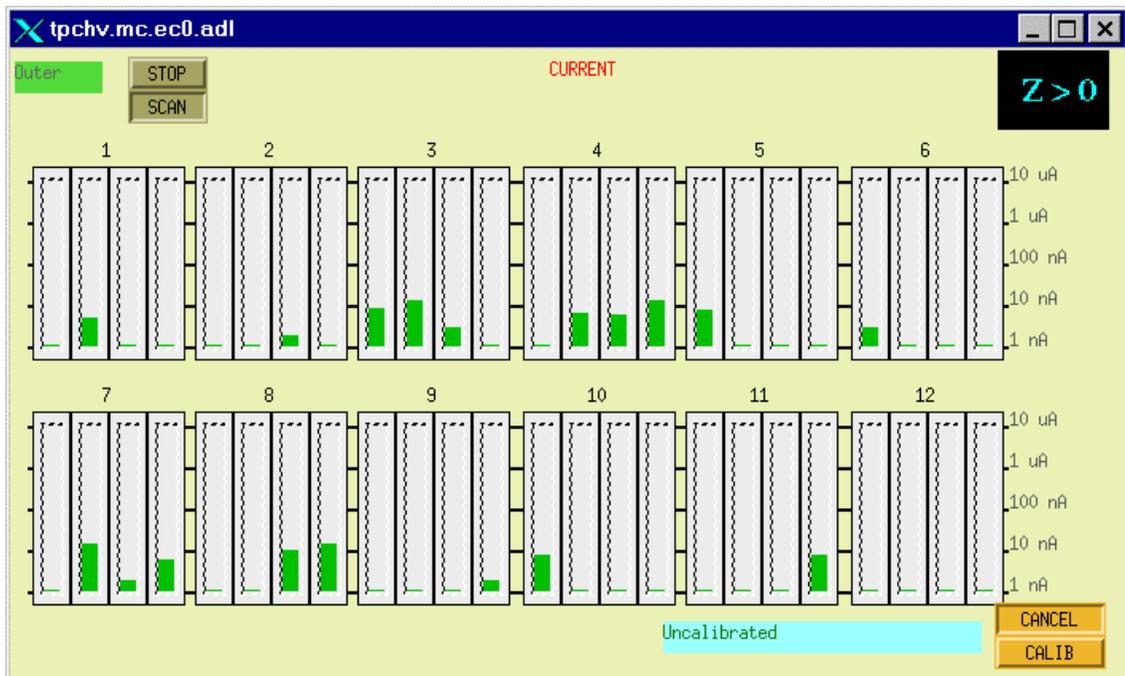


3. Check that the set point Demand Voltage for both Inner and Outer Sectors is 0.

- Click on the Outer “ENABLED” button. All the outer sectors should turn green. (WAIT!)
Do the same for the Inner sectors. The measured voltage should now read ~ 20 Volts.



- Before raising the voltage, you need to subtract the DC current offsets for all channels. For the outer sectors, click on the “Show I” button. There will be a drop down menu – click on “I (Z > 0) West” to view the current for 12 sectors at a time. The window will look like:



- To remove the DC offsets (some of which are negative), push the “Calib” button. The status window should read “Current is ready” and then “Calibration is in Progress” and then “Calibration done”. The currents should then all read ~ zero. This calibrates ALL 24 of the outer sectors.

- Do the same for the Inner sectors using the Inner “Show I” button.

IT'S TIME TO RAISE THE VOLTAGE!

The voltage is raised in steps up to the operating point. NEVER input the full HV from zero. It should take ~ 20 to 30 minutes to reach full voltage.

THE CURRENT OPERATING VOLTAGES ARE:

INNER	1170 V
OUTER	1390 V

THESE MAY CHANGE FROM TIME TO TIME – ALWAYS CHECK THE MAIN LOGBOOK BEFORE TURNING ON.

1. In the “ALL SECS” control window, type in 400 in the Outer DV window and hit CR. The voltage should slowly ramp up to 400 V. Remember, the readback program is slow, so you may only get one or two refreshes between 20 and 400.
2. When the Outer Sectors have reached 400, then type 400, CR in the Inner Sector DV window. Wait again.
3. Continue this way up to the operating point. Recommended steps are:

Outer: 400,800,1000,1200,1300, pause here and check currents, 1390

Inner: 400,800,1000,1100, pause here and check currents, 1170.
4. One step before maximum, and after reaching the setpoints, open the four “Show I” windows and check for excessive current draw. Any current over 10 nA is cause for concern. Lower the voltage on that section or sector and consult an expert. NEVER let a sector that is drawing current sit at full voltage.

NOTE: There is an additional built in hardware over-voltage protection for each channel. If you attempt to enter a demand voltage above this limit, the Lecroy card will immediately trip that channel (or channels). The hardware trip limit is set by a pot on the front of each HV card (common to 8 channels.) The present limits are Inner = 1210V, Outer = 1510 V.

5. The TPC is now at full operating voltage – see THE SECTION ON MONITORING A RUN.

RESETING A TRIP

HV trips due to overcurrent can be caused by a sector breaking down, excessive RHIC beam losses or bad Lecroy cards. If a channel or sector trips consistently, don't force the issue consult an expert.

1. A tripped channel(s) will be indicated by a red status indicator on the top level Anode GUI.



2. To reset the trip, first open the appropriate control window. For a single section (as above) just click on the section button. If two or more sections of a sector have tripped, it's usually easier to use the whole sector control window.
3. In the control window, set the demand voltage for the tripped channels to 0. (Make SURE you are entering in the right place – otherwise you will reduce the voltage on more than the tripped sector!)
4. In the top level Anode window, click on the appropriate “Clear Trips” button for inner or outer sectors:



5. In the control window for the tripped sections, raise the voltage in steps back to the operating point. Make sure to monitor the current carefully. Sections that re-trip for no known reason should be turned off and an expert notified.
6. Locate the “STAR TPC ANODES” three ring binder and log the trip. There is a separate page for each sector – log the date, time, section, the current trip limit, peak current trip limit and whether the beam was on. There is also a column for comments.

SERIAL SESSIONS

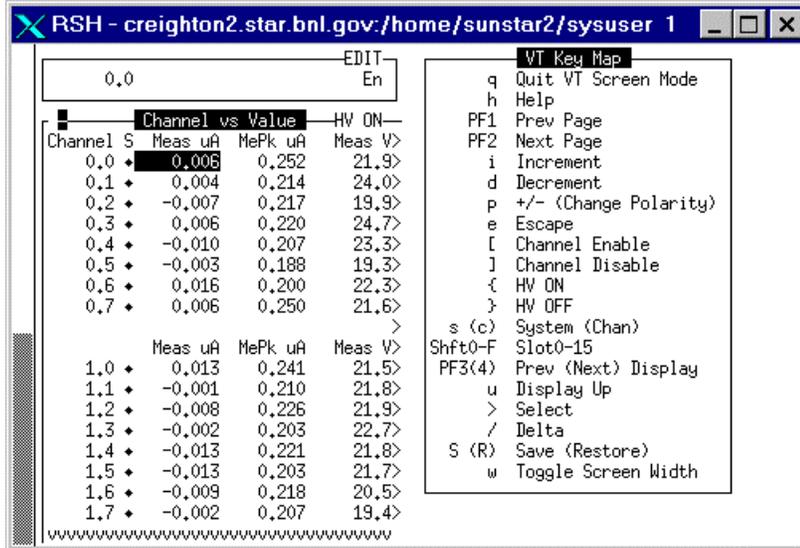
There is a parallel path into the Lecroy HV system using a serial connection for each crate (Inner and Outer). Commands can be entered from either the GUI or the serial sessions and the results will show up on both. In addition, some information is available through the serial line that is not apparent from the GUI. (Trip codes and hardware voltage limit being the most prominent). The entire system can be controlled in an emergency using the serial lines if the VME processors are down, for instance.

To open a serial session:

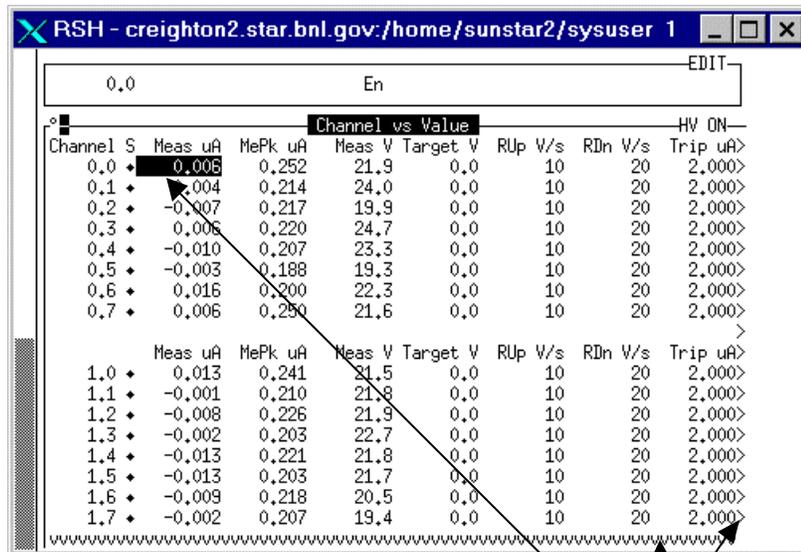
1. Select Desktop # 1 and double-click on the sc.session.xs shortcut located on the desktop.
2. At the sc prompt, type **telnet creighton2**, **CR**. Creighton2 is a Sun workstation located on the platform (Rack 2A8).

Username:
password:
3. At the creighton2 prompt, type “**tip a**” for the inner sectors. For a similar session for the outer sectors, repeat steps 1-3 but type “**tip b**”.
4. The response should be “connected”. Hit **CR**.

- At the prompt 0\ENTER "1450" to begin>, type **1450 CR**
- It will respond "Begin Serial Session" and then prompt 1\EDIT\1450>. Type **VT100 CR**
- The display will change to the following:



- This shows a partial display of the first two HV cards plus the help screen. Typing "w" toggles to the full display, shown below:



There is more information than can be displayed on one screen. The arrow (>) shows the direction where more data can be found. Use the keyboard arrow keys to move the cursor to different cells – moving all the way to the right or bottom will cause the display to shift over or down.

The rows are labeled by the crate slot number of the HV card and the output channel within the card. Each CARD controls TWO sectors (either inner or outer).

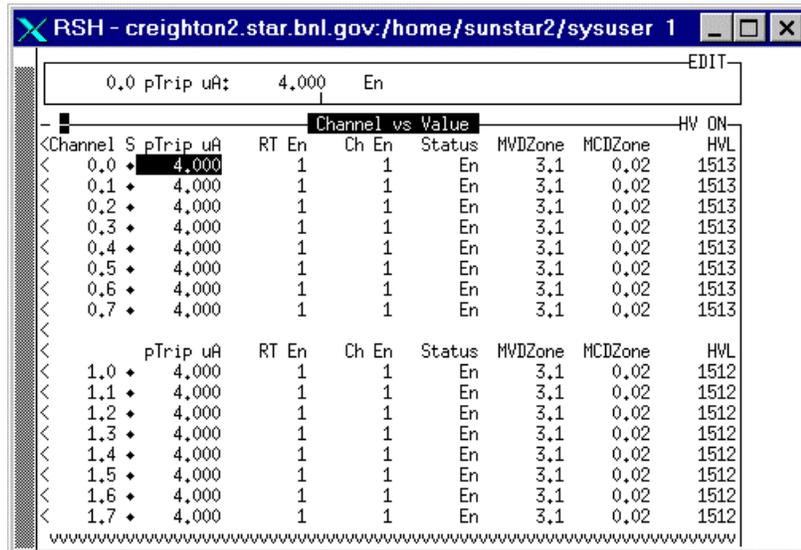
A translation table between the serial window designation (Card slot #.channel #) and the actual Sector & Section is shown below :

INNER			INNER			Outer			Outer		
Lecroy	Sector	Section									
0.0	1	1	6.0	13	1	0.0	1	5	6.0	13	5
0.1	1	2	6.1	13	2	0.1	1	6	6.1	13	6
0.2	1	3	6.2	13	3	0.2	1	7	6.2	13	7
0.3	1	4	6.3	13	4	0.3	1	8	6.3	13	8
0.4	2	1	6.4	14	1	0.4	2	5	6.4	14	5
0.5	2	2	6.5	14	2	0.5	2	6	6.5	14	6
0.6	2	3	6.6	14	3	0.6	2	7	6.6	14	7
0.7	2	4	6.7	14	4	0.7	2	8	6.7	14	8
1.0	3	1	7.0	15	1	1.0	3	5	7.0	15	5
1.1	3	2	7.1	15	2	1.1	3	6	7.1	15	6
1.2	3	3	7.2	15	3	1.2	3	7	7.2	15	7
1.3	3	4	7.3	15	4	1.3	3	8	7.3	15	8
1.4	4	1	7.4	16	1	1.4	4	5	7.4	16	5
1.5	4	2	7.5	16	2	1.5	4	6	7.5	16	6
1.6	4	3	7.6	16	3	1.6	4	7	7.6	16	7
1.7	4	4	7.7	16	4	1.7	4	8	7.7	16	8
2.0	5	1	8.0	17	1	2.0	5	5	8.0	17	5
2.1	5	2	8.1	17	2	2.1	5	6	8.1	17	6
2.2	5	3	8.2	17	3	2.2	5	7	8.2	17	7
2.3	5	4	8.3	17	4	2.3	5	8	8.3	17	8
2.4	6	1	8.4	18	1	2.4	6	5	8.4	18	5
2.5	6	2	8.5	18	2	2.5	6	6	8.5	18	6
2.6	6	3	8.6	18	3	2.6	6	7	8.6	18	7
2.7	6	4	8.7	18	4	2.7	6	8	8.7	18	8
3.0	7	1	9.0	19	1	3.0	7	5	9.0	19	5
3.1	7	2	9.1	19	2	3.1	7	6	9.1	19	6
3.2	7	3	9.2	19	3	3.2	7	7	9.2	19	7
3.3	7	4	9.3	19	4	3.3	7	8	9.3	19	8
3.4	8	1	9.4	20	1	3.4	8	5	9.4	20	5
3.5	8	2	9.5	20	2	3.5	8	6	9.5	20	6
3.6	8	3	9.6	20	3	3.6	8	7	9.6	20	7
3.7	8	4	9.7	20	4	3.7	8	8	9.7	20	8
4.0	9	1	10.0	21	1	4.0	9	5	10.0	21	5
4.1	9	2	10.1	21	2	4.1	9	6	10.1	21	6
4.2	9	3	10.2	21	3	4.2	9	7	10.2	21	7
4.3	9	4	10.3	21	4	4.3	9	8	10.3	21	8
4.4	10	1	10.4	22	1	4.4	10	5	10.4	22	5
4.5	10	2	10.5	22	2	4.5	10	6	10.5	22	6
4.6	10	3	10.6	22	3	4.6	10	7	10.6	22	7
4.7	10	4	10.7	22	4	4.7	10	8	10.7	22	8
5.0	11	1	11.0	23	1	5.0	11	5	11.0	23	5
5.1	11	2	11.1	23	2	5.1	11	6	11.1	23	6
5.2	11	3	11.2	23	3	5.2	11	7	11.2	23	7
5.3	11	4	11.3	23	4	5.3	11	8	11.3	23	8
5.4	12	1	11.4	24	1	5.4	12	5	11.4	24	5
5.5	12	2	11.5	24	2	5.5	12	6	11.5	24	6
5.6	12	3	11.6	24	3	5.6	12	7	11.6	24	7
5.7	12	4	11.7	24	4	5.7	12	8	11.7	24	8

The columns in the serial session window are as follows:

Channel	Output	
S (status)	Output	Blank = disabled, ♦ = enabled, ⊥ = tripped
Meas μ A	Output	Measured current (not baseline corrected)
MePk μ A	Output	Measured peak current (~ .2 -.3 even with 0 volts)
Meas V	Output	Measured voltage
Target V	Input	Demand voltage
Rup V/s	Input	Voltage ramp up rate (should be 10 V/s)
Rdn V/s	Input	Voltage ramp down rate (should be 20 V/s)
Trip μ A	Input	Current trip limit (should be 2.0 μ A)

Shifting the display over reveals more columns:



pTrip μ A	Input	Peak current trip limit (should be 4.0 μ A)
RT en	Input	Ramp trip enable (trips a channel during ramp up is current exceeds 40 μ A (should be 1)
Ch En	Input/Output	Enable status (0=disabled, 1=enabled)
Status	Output	Channel status (Shows trip codes)
MVDZone	Input	Voltage Dead Zone – variations in measured voltage smaller than this value will not be updated on the screen (should be 3.1 V)
MCDZone	Input	Current dead zone – variations in measured current smaller than this value will not be updated on the screen (should be 0.02)
HVL		Hardware voltage trip limit – set by front panel pot on the card. Outer = 1510 Inner = 1210

9. To control the HV you only need a few commands:

Channel S	Meas uA	MePk uA	Meas V	Target V	RUp V/s	RDn V/s	Trip uA
0.0	0.006	0.252	21.9	0.0	10	20	2,000
0.1	0.004	0.214	24.0	0.0	10	20	2,000
0.2	-0.007	0.217	19.9	0.0	10	20	2,000
0.3	0.006	0.220	24.7	0.0	10	20	2,000
0.4	-0.010	0.207	23.3	0.0	10	20	2,000
0.5	-0.003	0.188	19.3	0.0	10	20	2,000
0.6	0.016	0.200	22.3	0.0	10	20	2,000
0.7	0.006	0.250	21.6	0.0	10	20	2,000

VT Key Map	
q	Quit VT Screen Mode
h	Help
PF1	Prev Page
PF2	Next Page
i	Increment
d	Decrement
p	+/- (Change Polarity)
e	Escape
[Channel Enable
]	Channel Disable
{	HV ON
}	HV OFF
s (c)	System (Chan)
Shft0-F	Slot0-15
PF3(4)	Prev (Next) Display
u	Display Up
>	Select
/	Delta
S (R)	Save (Restore)
w	Toggle Screen Width

- { Turns the HV ON for the whole crate.
- }
- [Turns the HV OFF for the whole crate
-]
- [Enables the HV for the channel (row) that has the cursor (ie channel 0.0 above)
-] Disables the HV for the channel.
- Shft 0-B Scrolls up/down to slot (0 – B) There are 12 slots occupied in each crate.

To change the target (demand) voltage for ONE channel, use the arrow keys to move the cursor to the "Target V" column for that channel. Then type in the needed voltage and hit CR.

To change the target voltage for multiple channels, use the select key. First, move the cursor to the "Target V" column of the first channel to change. Then type > and use the down arrow to highlight more channels. When all channels of interest have been highlighted, type in the desired voltage and CR. Thus, to change 0.0 – 0.7, the window looks like this. The new target voltage appears in here:

Channel S	Meas uA	MePk uA	Meas V	Target V	RUp V/s	RDn V/s	Trip uA
0.0	-0.006	0.216	20.7	0.0	10	20	2,000
0.1	0.005	0.216	22.7	0.0	10	20	2,000
0.2	-0.005	0.183	22.5	0.0	10	20	2,000
0.3	-0.007	0.190	20.5	0.0	10	20	2,000
0.4	-0.008	0.194	22.2	0.0	10	20	2,000
0.5	-0.010	0.217	20.1	0.0	10	20	2,000
0.6	-0.003	0.199	22.1	0.0	10	20	2,000
0.7	-0.005	0.219	20.9	0.0	10	20	2,000

Since there are only 4 sectors visible in the serial session windows at a time, it is NOT recommended as a method for operating the entire TPC. It is useful for checking that the slow controls GUI is operating properly or for resetting one or two channels.

TURNING OFF

If the TPC is to be off for some time it is best to reduce the voltages to zero and close all the active windows properly. This includes the serial sessions, VME terminal server windows and the GUI. Sessions that aren't closed out can cause problems later.

SERIAL SESSIONS

1. Do the following for each window (inner and outer):
2. Type **q**. This gets back to the “\EDIT\1450>” prompt.
3. Type **quit CR** It will say “bye bye”. Type **~.** (tilde, period) This will end the tip session and return to the creighton2 prompt. Type **exit** to get to sc then **exit** again to close out.

SCSERV SESSIONS (VME)

1. Do the following for both 9006 (inner) and 9013 (outer).
2. Type **CTRL J**. This will get the telnet prompt. Type **quit** to get back to sc then **exit** to close.

SLOW CONTROLS GUI

1. Using the “ALL SECS” control window, set the demand voltage for inner and outer to 0.
2. Wait for the voltage to ramp down. When the measured voltage reads ~ 20 V, push “Disabled” for both inner and outer.
3. When the status turns grey, return to the main GUI and click “HV OFF” for both. The HV status lights will turn grey.
4. Close all auxiliary windows and then close the main Anode GUI.

TROUBLESHOOTING

1. All the anode HV are on and one of the VME processors is spewing out error messages and the ARCNET light is red! Can I safely reboot?

YES – The Lecroy stores the setpoints locally and the HV will stay on while the VME reboots. All trip functionality is also working.

2. The TPC is up and running and all of a sudden ALL the HV go off (including gated grid and cathode) and there is a loud beeping noise. What the hell?

Gas alarm – some critical gas system parameters (methane content, TPC pressure etc) are tied into the interlock system. Under certain conditions, ALL TPC HV are turned off. To recover after the gas system is operational again, first run all demand voltages (for all systems) to zero and start from scratch.

XI. MONITORING THE TPC

MONITOR COMPUTERS:

The TPC currently has been assigned 4 computers for online monitoring:

CHAPLIN.STAR.BNL.GOV	130.199.88.80
ASTAIRE.STAR.BNL.GOV	130.199.88.81
ONLLINUX1.STAR.BNL.GOV	130.199.89.57
ONLLINUX3.STAR.BNL.GOV	130.199.89.59

CHAPLIN is the main controls computer – it has the virtual desktop set up and all the EXCEED shortcuts. CHAPLIN must be reserved for TPC only.

ALL CONTROL FUNCTIONS FOR THE TPC SHOULD BE RUN BY ONE PERSON USING CHAPLIN!

After bringing up all systems, CHAPLIN should be used to display the ANODE top level GUI to watch for trips. I also usually keep the two scserv VME session windows up (for reboots) and the two serial sessions for Lecroy. This is cluttered but useful.

ONLLINUX1 should be used to display the field cage and cathode top level GUI's.

To get the display up on the Linux boxes:

1. Login Username:
 Password: (yes it's different from the PC's)
2. After logging in, click on the terminal emulation icon at the bottom of the screen (looks like a small monitor)
3. At the onllinux1 prompt, type: **telnet sc**
4. Log in to sc Username:
 Password:
5. At the sc prompt, type **xhost + (CR)** then **tpc_top (CR)**
6. This will bring up the top level TPC GUI. Bring up the Cathode and Field cage GUI's.

ONLLINUX3 should be used to display the gated grid GUI. Log in to ONLLINUX3 the same way as 1, bring up the top level GUI and then the gated grid GUI.

ASTAIRE can be used for other functions. Typical uses would be for the alarm handler (slow controls), data archiver display, pad monitor etc.

As the run progresses we will be developing check lists for the TPC operator. Until things get more specific, the following things should be watched closely:

1. Anode trips – also bring up the 4 current displays from time to time to look for excessive current.
2. Cathode voltage and field cage currents.
3. Gated grid voltages within specs (green or yellow)
4. A good idea of the overall health of the TPC can be learned from the pad monitor. The operator should always look at some events at the start of a run and after TPC parameters have been changed.
5. Fill out the TPC gas system checklist once per shift.

SOME OPERATIONAL NOTES:

RHIC CLOCK

The pad signals from the TPC are digitized using a master clock. During normal operations we plan to use the RF clock supplied by RHIC (= 9.33866 Mhz). If this clock falters (misses > 2 cycles), the STAR trigger system switches to an internal oscillator (= 9.21598 MHz) and keeps this clock until commands are issued to go back to the RHIC clock. It is thus possible to take TPC data using the wrong clock! There are two ways to check on this –

1. Hank Crawford has set up a scaler in the DAQ room (Rack DA3) which displays the approximate clock frequency currently in use. It is only accurate enough to tell which clock is in use.
2. To measure the frequency precisely, a BNC cable has been run from the TPC TCD on the platform to the bottom of Rack DA3 (labeled “DAQ”). Craig Consiglio has an accurate frequency meter.

In general, always take data with the RHIC clock.

GLOBAL METHANE SNIFFER:

As described in the TPC interlocks manual, CA-D maintains a methane sniffer system located on the platform in Rack 2A2. This system draws air samples from 7 places around the face of the

TPC and also samples the cooling air coming from the Inner Field Cage region. If this sniffer detects methane at the level of ~ 15% LEL (Lower Explosive Limit) the Global Interlock System will cut power to the platforms and send the TPC gas system into purge mode, clearly a major alarm. This has never happened, and it never should.

However, the sniffer system can (and frequently does) go into a fault condition. This will also set off a Global interlock alarm, but the system will take no further action. (See the global interlocks manual). A fault condition is usually caused by abnormally low gas sampling flow, caused by a clogging of the filters in the system. A fault in this system requires notification of a TPC and Global expert and the CAS watch (MCR).

It may be possible for STAR to continue running in this condition for a short time, but that would have to be negotiated.

TPC operators and shift leaders do not have the authority to make this decision alone.

For a fault condition, it is necessary to ask for an access. Notify STAROPS and the CAS watch. The sample flow is measured by a flow meter in the upper sniffer box in Rack 2A2. The nominal flow is ~ 5, with a red arrow indicating nominal. A flow of ~ 3 will cause a fault.

As a matter of course, for any access, operators should go in and check this flow.

COOLING WATER and CONDENSATION:

As stated in the section on the FEE's:

The cooling water for all TPC electronics is supplied by the TPC water skid located in the second floor utility room at STAR (east end of assembly building.) The skid is designed to supply water at a temperature of 75 ° F. The skid exchanges its heat with the STAR Modified Chilled Water (MCW) which is the same water that cools the platform and DAQ racks. Typically, the MCW temperature needs to be 60 – 62 °F for the TPC skid to maintain its setpoint when the FEEs are powered.

For operations during the summer, humidity in the WAH and DAQ room may rise enough to cause condensation problems. This can (and has) caused enough water to condense that the leak detection system alarms, shutting down power to the affected racks. (See Global Interlock Manual). If humidity becomes a problem, it may be necessary to make a decision to raise the MCW temperature to prevent condensation. (The MCW set point is changed by the CAS pump room tech.)

However, this has implications for the TPC, SVT and RICH which share TPC water. The TPC water typically regulates at ~ 12°F above the MCW temperature.

IT IS VERY IMPORTANT TO KEEP THE TPC TEMPERATURE BELOW 80 ° F. TEMPERATURES ABOVE 80 CAN RESULT IN STRUCTURAL DAMAGE TO THE TPC. IF IN DOUBT, POWER OFF THE FEE'S AND CALL AN EXPERT.

TEMPERATURE MONITORS:

Thermocouples (120 total) have been placed on the TPC FEE/RDO cooling manifolds to monitor the temperature. The readings from these thermocouples are recorded by a PC which is located in Rack 2A4 on the platform. To see the current readings and view past history, use Netscape or Explorer to go to <http://tpctemp.star.bnl.gov/> The readings are updated every few seconds, and at the bottom of the page it is possible to pull up a graph of any individual thermocouple (or the average) for the past hours or days.

Temperature, humidity and dew point in the WAH can be read remotely by clicking on the “Dew Point” button on the top level TPC GUI. The meter is located in Rack 2A8. A similar meter is located in Rack DC2 in the DAQ room.

BEAM LOSSES AND THE TPC:

Currently (5/2000), the TPC has not operated with colliding beams so we have no operational experience. Last summer's brief look during RHIC operations with one ring demonstrated that the TPC could not stay on due to multiple anode trips. Until RHIC operates stably we do not know what the final behavior of the TPC will be. We clearly need to be very conservative at the beginning so as not to do irreversible damage. Therefore, we will operate under the following guidelines:

The TPC is to be kept OFF unless RHIC has “stable” colliding beams with minimal losses, or RHIC is completely off and STAR is running a cosmic trigger. Exceptions to this rule can ONLY be granted with the express permission of Blair Stringfellow or Howard Wieman.

SPECIAL RUNS:

In addition to normal data runs it is necessary to occasionally take special “bookkeeping” runs for the TPC:

1. Normal pedestal runs – pedestal runs are usually taken before each data run in order to have the latest rms values stored in DAQ for pedestal subtraction. No action is needed by the TPC operator – just ask DAQ for a pedestal run. Typically, ~ 50 events are taken to get a good RMS value. For normal pedestal runs, ONLY the RMS values are saved.
2. Full pedestal runs – to study FEE noise etc it is sometimes necessary to take runs where ALL pedestal values for ALL FEE's are saved to disk. This is a large amount of data, so these runs are usually < 10 events and are taken rarely.
3. Geometry events – a special run by DAQ which checks the FEE and RDO connectivity. In a geometry event, each FEE reads out a value equal to its FEE

number. The pad monitor has been set up to read these geometry events and color code bad FEE's. We currently have a baseline run which documents the bad FEE's. We plan to take additional geometry runs throughout the data taking to monitor the electronics.

ASIC PARAMETERS:

The cluster finding algorithm's in DAQ use four so-called ASIC parameters to define what hits are considered to be valid (ie what hits will be kept). The definition of these parameters can be found on the DAQ web pages

(http://daq.star.bnl.gov/~daq/HARDWARE/ASIC/asic_spec.pdf

and

<http://daq.star.bnl.gov/~daq/HARDWARE/ASIC/figure6.pdf>)

Also, Roy Bossingham has documented some of this – see
http://www.star.bnl.gov/STAR/html/tpc_1/tpc.html

We are currently (5/2000) running the following parameters:

Sequence High = 0

Sequence Lo = 2

Threshold High = 3

Threshold Lo = 1

XII. EXPERTS CALL LIST

Blair Stringfellow – TPC Subsystem Manager

All current numbers posted in control room and gas mixing room

Howard Wieman – TPC Godfather

Office X7762
Home 631-734-2514
Cell 631-810-0977

Alexei Lebedev – Laser and TPC Water Skid

Office X3101
Home 209-9887

Leonid Kotchenda – Gas system

Numbers posted in gas mixing room when he's here

Jim Thomas – Interlocks

Office X3918
Home 631-928-8661

Geno Yamamoto – Gated Grid

Office X7596
Home

Dennis Reichhold – Slow Controls

Office X7803
Home 631-642-9373